THURSDAY, FEBRUARY 5, 1920.

THE NEED FOR AIRCRAFT RESEARCH.

UNDER the stimulus of war the development of aircraft was marvellously rapid, so much so that it not infrequently happened that by the time a squadron of aeroplanes of new and improved design was ready to take the air it was regarded as little else than an obsolete type by its own designers. But with a rate of wastage so high as war conditions made inevitable, one had to get accustomed to such an advance every six months as only the new mental attitude to mechanical developments that the war forced upon us could grasp without surprise. All this is now past. The factories are largely turned to fresh uses, and their skilful staffs scattered to new fields of labour. Even the scientific force of the Government has for the most part returned to the Universities from which it came—notably Cambridge and Oxford.

What is now to happen? Before this question can be answered it must be premised that consequent on the purpose of all this tremendous effort—the defeat of the enemy—having been finally achieved, the diversion of the means to other purposes is no more to be wondered at than regretted; furthermore, we may hope that the need for the re-creation of any such force is remote enough to enable us "to sleep o' nights." The validity of this hope must, however, depend on the sway of politics, and on the political methods followed by the Great Powers—whether a chauvinistic policy be adopted or earnestly avoided.

The enemy to-day is the geographical position with which this country is endowed: as unfavourable for air developments as it is favourable for maritime power. England is not on any air route to anywhere, and its climate deserves, from the air navigator's point of view, all that has been said against it. The sheer march of natural events will not make us an air Power as it has made us a naval Power. Any such result will need to be the consequence of intensely directed effort. But if such an effort can be presumed, then great consequences will ensue, for an air force which can be taught to encounter British climatic conditions and rise superior to them—with the implied possession of the best scientific means of assistance on the ground and in the aircraft—will have been trained in as hard a school as any in the world, and therefore be ready to gain an ascendancy in the easier conditions to be found almost everywhere else.

The experience of the last five years has shown that we have exactly the right kind of *personnel* for air endurance and skill; the work is temperamentally suited to the British type of youth. The aircraft themselves are the best to be found anywhere, and although this does not imply finality it is probable that future important developments will lie in some change of principle, whether thermodynamic (by modification of cycle or change of fuel) or aerodynamic, rather than in greatly improved efficiency in detail. We may, in fact, have to repeat in another fashion our war experience and once more face fundamental problems; we shall not be pressed for time, which will be a great gain, but we shall need all the assistance which can be got from minds trained in the fundamentals of science and as ready as heretofore to face entirely novel conditions. The Universities, at which many of such minds are now again engaged, must help. This, however, is not the most pressing problem; the urgent need is for the provision of means with the utmost rapidity to enable flying in this country, whatever its climate, to be as regular and safe for the traveller as it will surely become in the very near future in other countries.

When the weather is reasonable it is the custom to select that altitude of flight which enables best advantage to be taken of a favourable wind, and perhaps, when flying over Central Africa, that height which adds a pleasant temperature. Under normal winter conditions in this country quite other considerations apply. If the conditions are such as to create, or even to suggest the creation of, local fogs, pilots will choose their altitude from quite another motive; their aim will be to select that altitude which keeps them always within sight of the ground, so that if a fog, or heavy mist, is encountered at ground level, a landing can at once be made. Very often the fog or cloud is not of great thickness, and it would be easy to climb right through it and so to fly in sunshine under a blue sky. By astronomical means the position of the craft could be checked from time to time, and there need be no fear of being blown out to sea when prepared only for a limited number of hours' flight. What makes such flying impossible is not the uncertainty of position, but the doubt whether, when the pilot wishes to land, he will find the lower cloud- or fog-level actually resting on the ground. It is unpleasant enough to walk even a hundred steps along an empty road with one's eyes shut—how much less attractive when one's speed is 100 miles an hour and the feeling of having one's feet on the ground is absent! Unless

this difficulty can be removed, the kind of flying which the future demands and other countries can give can never be learnt or practised in this country.

The first need is for some means of flying steadily through thick cloud, either for the purpose of climbing above it, or to approach through it nearer to the destined aerodrome. This problem has lately been solved by the invention of a "turn indicator" which enables the pilot, whether he can see the ground or not, to know when the machine is being flown straight, and it has the valuable effect of allowing the readings of the compass to be relied on; so the gain is double. But in addition to this it is necessary to provide close co-operation with the ground whenever it is wholly or partially fog-enshrouded. The pilot must be told whether his intended aerodrome is fog-free, and, if not, what other aerodromes near his route are sufficiently clear of fog to be safe havens; this will presumably be by means of some increased efficiency in the wireless telephone. Next to this in importance is some means of indicating or conveying to the pilot his height above the ground that happens to be immediately below his machine. These and other such aids are the kind of requirements needed to make all-the-year-round flying possible in this country. It is only a part of the wide field for research, but it is of vital consequence, and it certainly needs (as it is, of course, receiving) Government support, since the immediate financial reward of success must be slight. Moreover, the work is one of public utility, and should be so treated.

Force is lent to what is here urged by the consideration that the air fleet to be maintained by the Government in the near future is so small that it is only by calling in the aid of private craft that the possible needs of an emergency can be met. For this economical procedure to prove a success it is necessary that civil aircraft should exist in sufficient numbers. To facilitate this calls for the encouragement of all who have ability to assist in making flying safe, in making it popular, in making it efficient.

PHYSIOLOGY OF MUSCULAR EXERCISE.

The Physiology of Muscular Exercise. By Prof. F. A. Bainbridge. (Monographs on Physiology.) Pp. ix+215. (London: Longmans, Green, and Co., 1919.) Price 10*s.* 6*d.* net.

IT may reasonably be doubted whether any two physiologists would deal with the subject of muscular exercise along similar lines, nor is it desirable that this should be so, the subject being so complex and presenting so many different points of view. A comparison of the present volume with the writings of thirty years ago on the same subject is an instructive demonstration of the fact that physiology, as regards certain of its branches at least, has in the course of a generation reached a stage at which experimental results begin to show an integrative connection with problems of a broad and complex nature.

It is with the wonderful co-ordination of functions which is displayed in muscular exercise that the book chiefly deals. The energy usage of the body in exercise may be from eight to twelve times that during rest, and of this about one-third may, in the most favourable circumstances, appear as work; this energy is ultimately supplied by oxidation, chiefly of carbohydrates, and the central point of the problems of the physiology of muscular exercise is that the muscles suddenly demand from the blood a supply of oxygen which is from ten to twelve times what they receive when at rest. "If the body is to work efficiently and to develop its physical powers to their full extent, it is absolutely essential that the movements of the muscles on the one hand, and the activities of the circulatory and respiratory systems on the other hand, should be co-ordinated and integrated into a harmonious whole" (pp. 3–4).

The complex co-ordination of circulation and respiration is to a great extent effected by the central nervous system, though the heart and blood-vessels are to some extent autonomous. Chaps. ii. to vii. deal with an analysis of the changes by which the blood and the organs of circulation and respiration are adapted to their several needs. The heart is itself a muscular machine working with a gross efficiency of 20–30 per cent., and the adaptation of this organ is very fully discussed. This is important, since, in ordinary circumstances, it is the working power of the heart which is the limiting factor to the amount of exertion which is possible in any individual; though training may improve the heart, "no man can be an athlete who does not possess a powerful (*i.e.* a muscular) heart." At high altitudes, on the other hand, the limiting factor seems to be the rate at which oxygen can diffuse through the pulmonary epithelium into the blood.

In the eighth chapter the manner of the exact balancing of the various partially autonomous systems by means of the central nervous system is discussed, and it is shown that, as in so many other instances in the body, the promptness in response to altered conditions is owing to the control of the central nervous system, while the coarser adjustment is effected by the influence of

various chemical or mechanical factors. The importance of the presidence of the nervous system is well seen in the reduced efficiency of the body during fatigue, and in the enhanced efficiency in circumstances where interest or emotion is aroused; in chap. xi. there is included a brief discussion of the subject of industrial fatigue, on which so much useful work has been done during and since the war, and one of the conclusions, that "the establishment of a uniform length of working day for all classes of manual workers would lead in many cases to inefficiency" (p. 183), is worthy of careful note.

The subject of training is discussed in chap. ix., and in chap. xii. it is shown that the differences between the circulation in the trained and untrained man can be extended to explain the condition of *effort syndrome*, or soldier's heart, in which the heart becomes inadequate to its work abnormally soon, owing to an impaired state of its nutrition.

Considered as a whole, the work is extremely good; it is well written, the viewpoint is broad, and the management of the arguments clear and convincing; indeed, a possible fault is that the inexpert reader may be misled as regards the complexity of the problems dealt with in such a clear and simple manner, or fail to appreciate what a vast deal of work lies behind some of the seemingly plain and obvious conclusions. Should this prove to be the case, it is but an indication of the excellent way in which the author has treated his subject. The references are to modern work chiefly, and in every respect the book is thoroughly up-to-date. Prof. Bainbridge is to be congratulated most heartily on having added to these valuable monographs such a cleverly written exposition of a difficult subject.

THEORIES OF SOUND PERCEPTION.

Some Questions of Phonetic Theory. Chap. v. *The Perception of Sound.* By Wilfrid Perrett. Pp. 39. (Cambridge: W. Heffer and Sons, Ltd., 1919.) Price 2*s.* net.

THIS work may be regarded as a continuation of the interminable discussion regarding the functions of the cochlea, or more particularly the part of the internal ear concerned in hearing. Theories of sound perception may be divided into two classes: first, those which assume that somehow analysis takes place in the cochlea; and secondly, those that relegate the analysis to the brain. The first theory also assumes that the principle of sympathetic resonance is the foundation of the method by which the organ of Corti in the cochlea works, while the second theory, as it involves ganglion-cells and part of the brain, has no experimental basis on which to rest, and leaves the function practically insoluble. The resonance theory owes its clear inception to Thomas Young and its development to Helmholtz. While it explains many experimental facts, and has been supported by many physicists and physiologists, it has now and again been assailed by critics who have advanced some form of the second theory, and founded their objection to the older theory mainly on facts which apparently cannot be accounted for by the Young-Helmholtz theory.

Mr. Perrett supports the second theory, and denies the existence of any resonating mechanism in the cochlea. In a short notice it is impossible to meet all his points, but it seems he does not meet the difficulties of the case. No explanation is offered of the extremely complicated organ of Corti, unless it serves some such purpose as is implied in the older theory; there are obvious difficulties relating to the fibres of the cochlear nerve; and the explanation is hopeless when we reach the ganglionic mechanism of the brain. On the other hand, the resonance theory, on the whole, meets the facts, and, if not free from objections, as Helmholtz and his supporters admit, it serves the purpose of a good theory by stimulating research, while it satisfies the mind. The same may be said of the retina and the action of light, and, indeed, of all the end-organs of special sense. Mr. Perrett, while he has evidently studied the subject, historically and otherwise, seems unduly biased against a fair presentment of the older theory, and we recommend caution and a wider view. J. G. M.

KASHMIR AND INDIAN SILKS.

The Silk Industry and Trade: A Study in the Economic Organisation of the Export Trade of Kashmir and Indian Silks, with Special Reference to their Utilisation in the British and French Markets. By Ratan C. Rawlley. Pp. xvi+172. (London: P. S. King and Son, Ltd., 1919.) Price 10*s.* 6*d.* net.

THIS volume forms a natural complement to the official report on Indian silk by Prof. Maxwell Lefroy and Mr. E. C. Ansorge recently published by the Government of India. In the official report the Indian silk trade is dealt with primarily from the Indian trade point of view; in the volume now under notice Indian silk is considered in its relation to the markets of Great Britain and France. As is well known, raw silk from India at the present day does not occupy a high place in the estimation of manufacturers, and it was with the object of ascertaining the

exact requirements of the British and French markets that the present investigation was undertaken by Mr. Rawlley with the financial assistance of the Carnegie Research Trust and the India Office.

In his inquiry the author visited nearly all the principal silk centres in this country and in France, and the chief value of the investigation lies in the fact that it has secured expression of authoritative views of the leading members of the trade. The wide ground covered by the inquiry can be only briefly summarised here. It will be sufficient to say that we have now a consensus of expert opinion that with adequate improvement in quality and reeling (embracing evenness in size, cleanliness, and uniformity of strength), together with improved trade organisation (mainly with a view to regular supplies), there is an assured market in this country, and in France, for Indian raw silks. The comparative success of the improved Kashmir silk, especially in the French market, is already a demonstration of this fact. As regards waste silk, and also wild Eri silk, the position is the same; given better quality, greater cleanliness, and improved trade organisation, there will be no difficulty in finding a European market for these products. The author's inquiry has performed a double function, inasmuch as it indicates the possibilities of a neglected source of supplies to the consumer of raw silk and an undeveloped outlet for the producer.

A GREAT INDUSTRIALIST.

George Westinghouse: His Life and Achievements. By Francis E. Leupp. Pp. xi+304. (London: John Murray, 1919.) Price 15*s.* net.

THE author, in his preface, regrets the lack of all those written records on which biographers usually rely for providing interesting personal reminiscences. Despite this, however, he has succeeded in compiling an interesting, straightforward narrative which will be inspiring to youth for the example it sets forth of success achieved by indomitable courage and persistent effort, and of fame won on sheer merit, without aid from influence or wealth.

Older readers will find the book of interest in so far as it provides an easily assimilated history of many of the important industrial developments of the past generation. On the other hand, they are likely to be disappointed by the feeling that the part accorded by the author to George Westinghouse in bringing about these developments falls short by no small distance of the part he actually played.

Mr. Leupp frankly admits that he confines himself to a portrayal of the human side of his subject. He dwells particularly on a certain bigness which he finds characteristic of George Westinghouse, who was large-minded and large-hearted, and had the grand style as an inventor, worker, optimist, and industrialist. "Nothing was ever big enough for him." Splendid as was the human side, and worthy as it is of this record, we share with the author the hope that one day some well-known technologist will compile the record of the great inventions and achievements of the man.

It is notable that Westinghouse did not excel at school and college, and that during his brief college career he admitted that he might have been more successful if he could have spared his time for study that he spent more pleasurably in investigating machinery and in making mechanical models. His ready grasp of the opportunity that led to his early connection with railroad work, and ultimately to his development of the air brake, with which his name will always be associated; his investigations into natural gas and its industrial application; his fair appreciation of the inventions of others and readiness to put them into commercial use; his fight for alternating electric current; his care for the welfare of his workpeople; his buoyancy, carrying him over financial crises of a most disturbing character; the esteem of his workpeople that held them to him through precarious times—these tell the man of unusual industrial capacity, personality, and courage.

The book does not possess any marked literary value, but all who are not debarred by its high price will find it worthy of perusal.

FARMING IN THE NEW ERA.

(1) *A Large State Farm: A Business and Educational Undertaking.* By Lt.-Col. A. G. Weigall and Castell Wrey. Pp. xiii+82. (London: John Murray, 1919.) Price 2*s.* 6*d.* net.

(2) *The Farmer and the New Day.* By K. L. Butterfield. Pp. xi+311. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1919.) Price 8*s.* 6*d.* net.

(3) *The Sugar-beet in America.* By Prof. T. S. Harris. (Rural Science Series.) Pp. xviii+342+xxxii. plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1919.) Price 2.25 dollars.

(4) *Strawberry-growing.* By Prof. S. W. Fletcher. (Rural Science Series.) Pp. xxii+325+xxiv plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 1.75 dollars.

(1) A GREAT deal is being spoken and written about the new era into which we are entering, and agriculturists are wondering what will become of their subject, and incidentally of

themselves. The problem is not peculiar to any one country: it is world-wide.

The British problem was discussed some time ago by Sir A. D. Hall in his book, "Agriculture after the War," and not long since by an anonymous writer in a recent number of the *Edinburgh Review*. One aspect of it is discussed by Lt.-Col. Weigall and Mr. Castell Wrey in the first volume on the list. These authors set out the advantages of the large 10,000-acre farm as a business proposition. The farm of 3000 acres, hitherto considered large, they regard as simply inconvenient; it is too small to be a really big farm, but too large to be a satisfactory small one. They suggest that the State should run one large farm as a demonstration and educational institute, and they consider that others would soon follow, with the result that the method would take its proper place in British agriculture. Many of the difficulties of farming disappear when the scale is made sufficiently large, and the authors make out a good case for the 10,000-acre farm. We doubt, however, whether they will induce any Government Department to embark in the business, Government trading being somewhat under a cloud for the moment; but a company might feel disposed to take the matter up.

(2) The American problem is discussed in the second of the volumes before us by Dr. Butterfield, the well-known president of the Massachusetts Agricultural College, who sets out his views with characteristic frankness, saying exactly what he thinks with the engaging candour that has made him so potent a factor in American agricultural life. One great difficulty Dr. Butterfield finds is that farmers are not, and rarely have been, prominent in the councils of the nation; consequently others have had to devise policies for them. The farmers of ancient Rome and the yeomen of medieval England were in a stronger position, and in Germany, Denmark, and Ireland farmers are a power in the land; in the main, however, they have had but little influence. Some serious consequences follow. The great majority of American farmers are said to receive insufficient return for their labours, the average labour income being only 400 dollars per annum. The middleman, on the other hand, obtains too many of the consumers' dollars; the system of distribution is in general against the farmer's interests. Still worse, there is no agricultural policy. Dr. Butterfield writes sternly about this deficiency in the United States, and notes with surprise the same lack of policy in this country and in the Labour Party's memorandum on reconstruction, of which otherwise he approves. He insists on the need for a strong agriculture, which, however, can eventuate only if the farmer conforms to the spirit of the new age. This calls for a better chance for the ordinary man, the intelligent planning of human progress, a reconciliation between organised effectiveness in human life that also leaves individuals and classes truly free, and an insistence on service to fellow men as the great motive in life.

We need not follow Dr. Butterfield in the elaboration of his thesis; he discusses the various agencies in American country life in their relationship to these four aspects of the new age. The position is similar to that dealt with by Sir Horace Plunkett in Ireland, whose famous slogan, "Better farming, better business, better living," has made a vivid appeal in the States also. More fortunate than Sir Horace, however, Dr. Butterfield has no religious problem, and is able to discuss the Churches as candidly as he does the schools. The author makes certain criticisms of the rural education system of the United States—the most remarkable scheme of educational activities on behalf of the farmer to be found in the world. Englishmen visiting the States have marvelled at its completeness; Dr. Butterfield's criticisms, after all, show that it is human; while sound in essentials, it is apt to go wrong in details.

(3) The two other books on the list furnish good examples of the educational work done by the agricultural experts of the States. Prof. Harris, the director of the Utah Experimental Station, describes the growth of sugar-beet in the States, and brings together a good deal of material previously scattered through many books, journals, and bulletins. The industry has developed there in a remarkable manner. In the 'sixties the production of beet-sugar was less than 300 tons per annum; now it is 800,000 tons. This astonishing development has not been at the expense of cane-sugar, for during the same period raw cane-sugar has risen from 200,000 tons per annum to 2½ million tons. The story of the beet-sugar industry in Europe is well known, and is one of the most interesting cases on record of a fostered key industry growing and flourishing. The history of the crop in America is not so well known, and the author devotes an interesting section to it, also reproducing photographs of some of the early pioneers. The first factory, established in Massachusetts in 1838, failed after two years. The second was established in Utah in 1842, and had the advantage of a considerable natural protection, imported sugar having to be hauled all the way from the Missouri River, and, therefore, costing no less than 40 cents to 1 dollar a pound in Salt Lake

City. But the promoters could not crystallise the sugar; they could only make syrup, and before long they gave up the business. The industry was not definitely established until 1890; development was fostered by means of tariffs, and was very rapid during the war. In the early days of the nineteenth century the percentage of sugar in the root was about 5; now it is about 16–18 per cent. It differs in the different varieties, and is affected by the soil and weather conditions. Sufficient irrigation in dry seasons increases the amount of sugar.

The great difficulty in dealing with the crop is the amount of labour involved in lifting. This is now obviated to a considerable extent by the use of suitable implements, two types of which are described.

The crop is liable to attacks by insect pests and fungi; no fewer than 150 species of insects feed on the beet, of which about forty are of economic importance; the number of fungus pests is small at present, but it is increasing.

(4) The last book on the list, on strawberry-growing, is by Prof. Fletcher, of the Pennsylvania State College. The author opens with the statement, which will be new to many people, that "the strawberry is distinctly North American. Most modern varieties sprang from species only found in the Americas. Progress in the domestication of the fruit was coincident with the introduction into Europe of American types." In 1910 the acreage under strawberries in the United States and Canada was 150,000 acres, said to be more than the combined acreage of all other countries.

Bearing in mind the results of fertiliser experiments at the Woburn fruit farm, the English reader turns with interest to discover what results have been obtained in America. Curiously few fertiliser experiments with strawberries seem to have been made. At the Missouri Station phosphates were beneficial, but nitrogenous and potassic manures were harmful. At the Tennessee Experimental Station no fertilisers proved effective. At Cornell phosphates and potassic fertilisers were beneficial, while nitrogenous manures were harmful. But the experiments lasted only a year or two, and hence the results do not yield as much information as they might as to the needs of the plant. In nature the strawberry flourishes on an acid soil, and in cultivation lime is not found necessary.

As usual in the Rural Science Series, the author brings into the book information on all aspects of the crop, dealing with such diverse subjects as the shape of boxes for packing, the raising of new varieties, insect and fungus pests, etc. It is obvious that no one man can be competent to deal adequately with all branches of the subject, but the general treatment is good and gives the practical man all the help he needs; there are also references to experimental station bulletins, where further information by experts on particular subjects can be obtained.

Some years ago productivity figures were worked out for the farm workers of the different countries of the civilised world. America easily headed the list, which was as follows:—

America	292
Great Britain	126
Germany	119
France	90
Italy	45

Looking through this Rural Science Series, edited by Dr. L. H. Bailey, and seeing how earnestly the authors strive to deal with the conditions actually obtaining in the States, we find at least a partial explanation of the striking superiority of the American worker. Such books could scarcely be written in this country as yet, but there are hopeful signs for the future. A body of young men and young women is gathering at the agricultural experimental stations and colleges of this country capable of doing good work that will bear comparison with anything done elsewhere, and there are increasing signs that their work is favourably and respectfully received by the agricultural community.

E. J. RUSSELL.

OUR BOOKSHELF.

The Building of an Autotrophic Flagellate: Botanical Memoirs. No. 1. By A. H. Church. Pp. 27. (London, etc.: Humphrey Milford and Oxford University Press, 1919.) Price 2*s*.

"THE story of the evolution of the plant regarded as expressed in simplest terms as an autotrophic flagellate of the plankton-phase from nothing at all but ionized sea-water" is the subject of Mr. Church's extremely condensed and technical paper. In reality it is rather the requirements of the problem than its solution which Mr. Church indicates, and, whilst he realises the magnificence of the factors with which he has to deal (the sea, for example, is "a medium complex beyond the possibilities of human computation"), he presents the results of much learning in huge unbroken and almost unintelligible paragraphs. Who, for example, would imagine that the following sentence refers to the origin of seaweeds from free-floating algæ? "In the case of initial benthic organism, the first inception of such a continuous deposit [he is talking of cell-walls] prepares the way for the general formula adopted in describing the events in the life of an algal

zooid. . . . In such wise the autotrophic zooid of highly differentiated anisokont habit may be visualised as passing on to the initiation of the series of the great marine group of the Phæophyceæ." Strange that an old Oxford teacher should have employed for his exposition a medium "complex beyond the possibilities of human computation."

Yet if the reader can summon up courage to face the repellent language of this tract he will find suggestions of extraordinary interest. The superiority of the botanist over the zoologist is emphasised; even "a tree is in many respects more entitled to respectful admiration than a man," unless, we presume, he be a botanist.

Human Personality and its Survival of Bodily Death. By Frederic W. H. Myers. Edited and abridged by S. B. and L. H. M. Pp. xiii + 307. (London: Longmans, Green, and Co., 1919.) Price 6*s.* 6*d.* net.

THE original two-volume work, published in 1903, is abridged by condensing the text and omitting the greater part of the appendices. The illustrative cases which are published form part of the text, and are nearly always quoted in full.

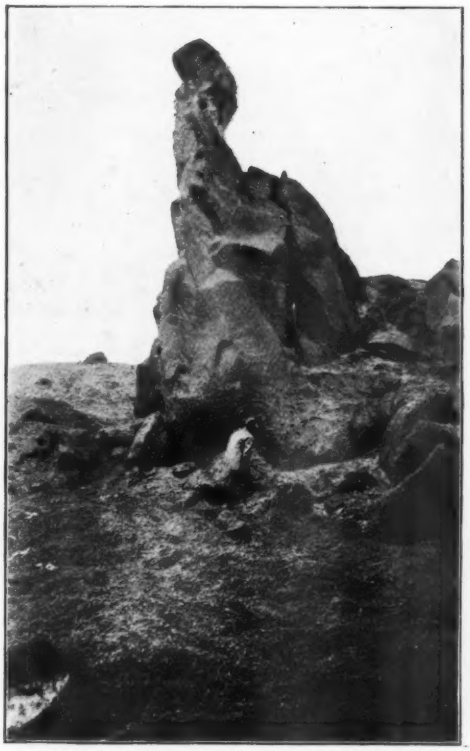
LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Nature of the Katmai Volcanic Gases and Encrustations.

THE fumarole activity following and continuing after the great Katmai eruption of June, 1912, has provided south-western Alaska with the first among the natural wonders of the world. The volcanic gases force their way to the surface over an area of more than fifty square miles. This area is covered with volcanic ash and pumice, largely distributed by an enormous flow of mud following the explosion of the Novarupta volcano, but preceding the outburst of Katmai ten miles to the eastward. The relatively coarse ash and pumice from Novarupta were not ejected to any considerable distance, but, falling locally, quickly melted the snow on the mountains, and, with the rainfall accompanying the eruption, slid down into the adjacent valleys, forming a viscous mass which poured down the Bering Sea slope of the peninsular axis for a distance of more than fifteen miles.

As the mud drained away, unlike the more fluid water,



Photo] [*J. W. Shipley.*

Photo] [*J. W. Shipley.*

FIG. 1.—Fractured sections of the Great Mud Flow. Note the conglomerate nature of the fragments and the irregular cleavage planes. Sometimes, however, the cleavage is quite regular, as shown in Fig. 2.

it left a very large residue adhering to the valley floor. Subjected to heat from below, the mud dried, caked, and was eventually baked. The contracting, hardening mass split and cracked according to the strains and stresses set up by the irregularities of the valley floor beneath. The Katmai volcanic ash lies conformably on top of this mud-flow. Apparently the order of the sixty-hour eruption of June, 1912, was:—(1) Novarupta explosion, followed by the great flow of mud; (2) Katmai eruption; and (3) the upthrusting of the lava plug of Novarupta. No ash covers this plug. It was the last major event to happen.

Photo [*J. W. Shipley.*

FIG. 2.—Cross-section of horizontal tunnel about fifteen feet below the surface of the mud-flow. Note the cleavage planes of the mud above the vent. One hundred feet from this is another horizontal tunnel seventy-five feet below the surface, and large enough to drive a team and wagon through. These have most probably been formed by the solvent action of superheated steam and hydrofluoric acid.

The mud-flow occupies the floor of the Valley of Ten Thousand Smokes described in this journal by Dr. Griggs ("The Eruption of Katmai," NATURE, August 22, 1918, vol. ci., p. 497). The volcanic gases force their way upward through this superincumbent detrital material, using the existing cracks and fissures, and dissolving out new channels where openings were not already available. As chemist of the 1917 Katmai Expedition, it fell to my lot to examine these gases and the encrustations deposited around the fumaroles.

The gases contain some of the strongest disintegrating agents known. Hydrofluoric acid and hydrochloric acid, together with superheated steam, proved to be the most common constituents of the outpouring gases, frequently issuing at a temperature above 400° C. Many fumaroles were so impregnated with these acids that it was impossible to breathe the vapours. The surface of the mud-flow surrounding some of the more acid vents was covered with ferrous chloride and impregnated with free hydrochloric acid. The presence of hydrofluoric acid in the emanations was accompanied by a deposit of amorphous silica around the vents, almost completely closing the orifices and forcing the gases to issue through cracks in the hot, baked silica. These deposits, sometimes 98 per cent. of pure silica and altogether anhydrous, formed dykes several feet high around the hotter vents.

This association of hydrofluoric acid and silica is not accidental. Hydrofluoric acid decomposes silicates, setting free the silicon as gaseous silicon tetrafluoride, and this in turn is decomposed in the presence of water, forming SiO_2 and free acid. The majority of the samples of encrustants brought back gave a qualitative test for fluorine, while quantitative results ran as high as 7 per cent.

Realgar and orpiment were found in conjunction with deposits of sulphur. Hæmatite in the form of "Venetian red" and small crystals of pyrites embedded in a matrix largely silica were common secondary reaction products of the volcanic gases. Hydrogen sulphide was almost ubiquitous.

Hygroscopic iron and aluminium salts formed in the throats of vents protected from the weather and at a temperature above 100° C. Unfortunately, these were highly deliquescent, and lost their crystalline form on exposure to the air.

The throats of several vents near Novarupta were lined with quantities of ammonium chloride crystals, almost 99 per cent. pure.

One of the most interesting deposits was a tarry substance found in the proximity of the ammonium chloride fumaroles, which proved on analysis to contain hydrocarbons of an asphaltic character.

Many of the fumaroles contained ammonium compounds in the issuing gases, strikingly indicated by the growth of algæ. Wherever blue-green algæ were

Photo [*J. W. Shipley.*

FIG. 3.—The surface of the mud is very deeply eroded by watercourses, and these are frequently hard to distinguish from the fissures. These gullies are in a very active area on the northern slope of Trident Volcano.

observed growing, there the issuing gases or encrustants contained ammonia; while, conversely, an active area not supporting algæ proved to have no trace of ammonia in its emanations or encrustants.

In connection with the presence of hydrofluoric acid, the deposits of sulphates, such as alum, are very significant. Potassium alum, appearing as lichen-like growths after every rainfall, covered the surface of the ash over many of the areas of activity. Sulphuric acid is a strong disintegrating agent, and its presence in the emanations gives a key to the formation of hydrofluoric and hydrochloric acids, for sulphuric acid acting on fluorides and chlorides sets free the more volatile halogen acids.

The volcanic ash and pumice which constitute the mud-flow have been highly altered by the passage of the volcanic gases. Analysis shows that in the vicinity of the vents the ash has lost a portion of its silica content, while the iron, calcium, and magnesium have been relatively concentrated. Sometimes the ash and pumice are completely disintegrated. Superheated steam containing halogen acids is a disintegrating agent that even rhyolite cannot withstand. The

Photo] [*J. W. Shipley.*

FIG. 4.—A typical volcanic vent. The gases were escaping from another hole some distance away along the horizontal tunnel. Note the thickness of the encrustants covering the tunnel. They consisted of silica, sulphur, fluorides, and compounds of iron.

presence of so many large vents, tunnels, and channels in the mud-flow may well be attributed to the action of the volcanic gases.

The nature of the emanations, and the continuous evolution of heat and gases for seven years, with little indication of any diminution in volume, indicate direct magmatic origin for the phenomena of this valley. The extrusion of semi-fluid lava from Novarupta and in the bottom of the Katmai crater may signify a similar approach of the magma to the surface in the Valley of Ten Thousand Smokes.

J. W. SHIPLEY.

Chemical Department, University of Manitoba, Winnipeg.

The Control of Scientific and Industrial Research.

ANNOUNCEMENT is made in NATURE of January 29 of the appointment of Mr. R. L. Frink to be director of research of the Glass Research Association, which has recently been formed as one of the Industrial Research Associations of the Department of Scientific and Industrial Research. The appointment raises a question which has intimate relations with scientific interests and progress, and it should not be permitted to pass without protest.

It has always been urged in the columns of NATURE, and accepted as a cardinal principle by men of science generally, that scientific research can only be rightly understood and sympathetically promoted by a director who has himself taken part in it. The essential qualification, therefore, of a director of research of each of the industrial research associations should be proved capacity for research; for without such aptitude the work undertaken is bound to be narrow, and the scientific aspects upon which progress ultimately depends to be neglected. This point of view, however, seems to have received secondary consideration only in the recent appointment; for what the secretary of the Glass Research Association says as to the qualifications of the director of research is: "Mr. Frink has a lifelong experience of the American glass trade and glass research, is well known to the foremost English glass manufacturers, and his appointment is welcomed by the British glass industry."

It is scarcely too much to say that this appointment has been received with intense astonishment by all scientific men connected with the glass industry, and by many glass manufacturers as well. In the glass industry, more, perhaps, than in any other, it was naturally expected that a director of research would be a man of distinguished eminence whose work was of proved scientific value; yet practically no such evidence is forthcoming in the case of Mr. Frink.

A scientific friend in America, who is recognised as one of the first authorities upon scientific matters connected with glass, tells me that Mr. Frink is not known as a research man or in research circles, but that he is highly spoken of by practical glass-makers "as a man of long experience in the window-glass trade who is accustomed to be called in as 'first aid' for furnace troubles, colour troubles, and like technical difficulties. This trade he has pursued for some years with success, and his reputation in this domain is among the best. He maintains a so-called laboratory and has a number of technical assistants, and, I fancy, has gathered together a considerable amount of rough-and-ready wisdom which has found extensive application in an industry where research laboratories have hardly been thought of until recently."

It seems quite possible that the Glass Research Association has secured the services of a very able, practical man, but in making the appointment the council of the association has negatived the policy elaborated with such care in the article published in NATURE of November 13 last: "The ideal director for this association is not an individual research worker whose glory is to work in splendid isolation, but is he who will bring *expert knowledge of the methods of scientific research* to bear upon these complex problems, who possesses such personality as to attract promising young research workers to his side . . . and to co-ordinate the efforts being made through the various laboratories, institutions, and works to which specific research and experimental work will be allotted." (Italics are mine.)

If the writer of that article, the temporary secretary of the association, had been a scientific man, he

would have realised that our greatest investigators rarely "work in splendid isolation," but that only a man who has proved his capacity as an investigator can lead and co-ordinate research. It is certain that British scientific men will not submit to control and direction from the practical man; thus a definite breach is opened between science and an important branch of industry.

It has not been sufficiently clearly realised that scientific and industrial research is passing out of the control of the recognised scientific and technical societies and institutions and of the universities into the hands of the Department of Scientific and Industrial Research, and, in accordance with Government policy, the secretary of this Department is an administrator without practical knowledge of science, industry, or research. The associations which are formed under the ægis of the Department are governed by councils upon which organised science is unrepresented, but to which the Department may nominate scientific men. To the council of the Glass Research Association the Department has nominated two scientific representatives, one of whom is in India. On the executive committee science is not represented; and when this appointment was discussed between that body and the secretary of the Department, the scientific aspects of the case can have received no consideration. As the Department controls funds for research which are vastly greater than those at the disposal of the Royal Society and all the other societies and universities put together, the outlook for science is a poor one unless scientific men are prepared to take united action with the view of securing a proper share in the control of research.

MORRIS W. TRAVERS.

The Predicted Shift of the Fraunhofer Lines.

MAY I submit the following two propositions for the consideration of relativists?

(1) An occurrence takes place at a point S. Light-signals are dispatched from S at the beginning of the occurrence to two observers A and A′, and signals are again dispatched at the conclusion of the occurrence. By means of these A and A′ measure the time of the occurrence to be dt and dt' respectively. Then

$$\sqrt{g_{44}}.dt = \sqrt{g'_{44}}.dt',$$

where g_{44} and g'_{44} are the values of Einstein's 44 potential at A and A′.

(2) An occurrence takes place at S, and is measured by an observer there to take the time dt. Another occurrence takes place at S′, and is measured by an observer there to take time dt'. By means of light-signals dispatched from S and S′ at the beginning and conclusion of each occurrence, an observer A measures the times of each occurrence to be equal. Then

$$\sqrt{g_{44}}.dt = \sqrt{g'_{44}}.dt',$$

where g_{44} and g'_{44} are the values of Einstein's 44 potential at S and S′.

Prop. (1) seems to be a correct inference from Einstein's theory, and prop. (2) is deduced by applying (1) to the occurrence at S as measured by S and A, and then to the occurrence at S′ as measured by S′ and A.

If these propositions are sound, how does the Einstein theory predict the displacement of the solar lines? For it seems to me that the criterion for "similarity" of two radiating mechanisms in different parts of a gravitational field is that the invariant space-time elements corresponding to one oscillation of each should be equal. For two mechanisms at rest in the field this condition reduces to $\sqrt{g_{44}}.dt = \sqrt{g'_{44}}.dt'$.

JAMES RICE.

University of Liverpool.

EINSTEIN's prediction of a shift of the Fraunhofer lines to the red can be analysed into two assertions:—(1) That the period of vibration of an atom at rest on the sun differs from that of a similar terrestrial atom; and (2) that this difference is preserved unchanged by the light-waves travelling from the solar atom to the earth, so that it is revealed by a comparison made in a terrestrial laboratory. It is the second assertion that is challenged by Mr. Rice; and, so far as I can make out, the same objection was at the root of the criticisms formerly made by Sir Joseph Larmor. Since criticism centres entirely round the second assertion, I will deal with it solely. I may state, however, that although I regard the first assertion as highly probable, I do not regard it as proved with complete rigour; and had the criticism been directed against this, I should have been much less willing to take sides in the controversy.

The interval ds between two events is a quantity having an absolute significance independent of co-ordinate systems; and when the two events take place at the same place, $ds = \sqrt{g_{44}}.dt$. Mr. Rice's first proposition states that if we have two light-pulses travelling from the sun to the earth, the interval ds between their passages through any point is the same all the way along the track. The statement has a certain appearance of plausibility, but I cannot see any definite argument in favour of it. Space-time round the sun is non-Euclidean; the geodesics have, accordingly, defined but rather complicated tracks, and there need be no constancy of interval between points on neighbouring geodesics. The rule deduced from Einstein's theory for comparing the passage of two light-pulses at the points A and A′ respectively is not $ds = ds'$, but $dt = dt'$, *provided the co-ordinates used are such that the velocity of light does not change with* t.

If we found that the velocity of light changed secularly, we should at once condemn our time-reckoning as non-uniform; accordingly, the proviso is satisfied in practice. With the co-ordinates most commonly adopted the velocity of light is $1-2m/r$, which depends on the position r, but not on the time t. Then if t_1 and t_2 are the times of the two pulses at r, t'_1, t'_2 the times at r', since the mean velocity of the first pulse $(t'_1-t_1)/(r'-r)$ has to be the same as the mean velocity $(t'_2-t_2)/(r'-r)$ of the second pulse, over the same course but at a later time, it follows at once that $t'_2-t'_1$ is equal to t_2-t_1, which proves the statement made. The time between the two light-pulses is preserved unchanged on the journey from the sun to the earth.

In his letter (NATURE, January 22, p. 530) Sir Joseph Larmor describes this condition, that the velocity of light (or the formula for ds) shall not contain the time explicitly, as "a reasonable assumption." I cannot see that any assumption is involved; nor can I agree that it is of "an absolute type." The well-known expression

$$ds^2 = -(1-2m/r)^{-1}dr^2 - r^2d\theta^2 - r^2\sin^2\theta d\phi^2 + (1-2m/r)dt^2 \quad . \quad . \quad . \quad (A)$$

is, in the first place, simply a particular integral of Einstein's differential law of gravitation. It can be shown that it is an appropriate solution for the case of an isolated particle. But there is a fourfold infinity of other solutions applicable to the same case; so there can be nothing absolute about this solution, or about the co-ordinates r, θ, ϕ, t which it defines. It is, in fact, often more convenient to write $r = r' + m$,

and use r' instead of r as our radial co-ordinate. Whether we use (A) or any other expression, we have to find out from the expression itself the meaning of the co-ordinates introduced. In the limiting case $m=0$, the above expression agrees with the formula for polar co-ordinates and time in a Euclidean world; hence it is usual to call r the distance from the sun and t the time. But there can be no exact identification of variables in a non-Euclidean world with quantities the definition of which presupposes a Euclidean world; and the only exact definition of r and t is that they are mathematical intermediary quantities which satisfy equation (A). The variable t is in no sense an absolute time; it is specifically associated with the sun, which in equation (A) is regarded as the only mass in the universe worth considering.

Without troubling about the approximate identification of t with our common notion of time, our results may be stated in the following form:—At a point in the laboratory (r=const.), dt_1 for a light vibration from a solar atom differs from dt_2 for a terrestrial atom. It follows from the formula (A) that ds_1 and ds_2 will differ in the same ratio, since we are now concerned only with the relation of dt and ds on the earth. The intermediary quantity t is thus eliminated; and the difference in the light received from solar and terrestrial sources is an absolute one, which it is hoped the spectroscope will detect.

A. S. EDDINGTON.

The Straight Path.

IN my book, "A Theory of Time and Space," I directed attention to the fact that in the simple four-dimensional time-space theory there are three types of plane in addition to three types of line.

On p. 360 I stated the following results:

"If A, B, C be the corners of a general triangle all whose sides are segments of one kind, then:

"(1) If the triangle lies in a separation plane, the sum of the lengths of any two sides is greater than that of the third side.

"(2) If the triangle lies in an optical plane, the sum of the lengths of a certain two sides is equal to that of the third side.

"(3) If the triangle lies in an acceleration plane, the sum of the lengths of a certain two sides is less than that of the third side."

These results were published in 1914, and, in spite of the fact that they were printed in italics, so that he who runs might read (that is to say, provided anyone should run on the occasion of reading my book), yet I still find writers continually making statements to the effect that the straight line in this geometry is the shortest distance between its extremities.

As a matter of fact, what I call a "separation line" lies in all three types of plane, and is, consequently, neither a minimum nor a maximum, while an "inertia line" can only lie in acceleration planes, and can easily be seen to be a maximum in the mathematical sense. Further, a triangle cannot have all its sides formed of segments of "optical lines."

I have long contended that the usual method of approach to what is generally called the "theory of relativity" is quite inadequate, and this is a further illustration of my contention.

Not only are our ordinary ideas as to space and time disturbed, but also our ideas of simultaneousness and our notions of "straight lines" in the resulting four-dimensional geometry.

From the midst of this wreckage a logical theory has to be constructed, and the difficulty is to find any firm basis at all.

In the course of my own work I succeeded in finding what appears to be such a basis in the relations of *before* and *after*.

On this basis I found it possible to construct a theory of time and space (apart from gravitation) which led to the same equations as those of Einstein, but of such a nature as to be independent of the particular observer, and therefore truly physical and devoid of the subjectivity which seems to cling to Einstein's theory.

These relations are, in fact, what might be described as *physical invariants*, and, with the help of certain postulates concerning them, they serve as a basis for a system of geometry.

If this investigation had been published in the German language it would doubtless have attracted more attention on the part of British physicists, who might then have added the ideas of *before* and *after* to their store of fundamental physical concepts. Instead of this, however, I have seen no mention of them at all in recent discussions on the so-called relativity theory. It is true, of course, that no analysis of Einstein's recent work has as yet been made in terms of the relations of *before* and *after*, but seeing that these have proved a sufficient basis for the simple theory corresponding to Euclidean space, and that such relations do actually hold in our experience, it does not seem unreasonable to suppose that with modified postulates they might serve as a basis for the more general theory.

With regard, however, to my statement that the straight line in the simple theory is not the shortest distance between its extremities, I can imagine some people casting doubts upon my veracity. For the benefit of those who do not believe me, I venture to give some simple arithmetical examples.

Taking v as unity, the length s of the segment of a separation line between elements the co-ordinates of which are (x_0, y_0, z_0, t_0) and (x_1, y_1, z_1, t_1) is given by the equation:

$$s^2=(x_1-x_0)^2+(y_1-y_0)^2+(z_1-z_0)^2-(t_1-t_0)^2.$$

Let A, B, C_1, C_2, C_3 be elements the co-ordinates of which are as follows:

	x	y	z	t
A	0	0	0	0
B	10	0	0	0
C_1	5	12	0	0
C_2	5	5	0	5
C_3	5	0	0	4

On substituting these values we get:

$$AB=10$$

$$AC_1=13 \qquad C_1B=13$$
$$AC_2=5 \qquad C_2B=5$$
$$AC_3=3 \qquad C_3B=3$$

Thus we have:

$$AC_1+C_1B>AB$$
$$AC_2+C_2B=AB$$
$$AC_3+C_3B<AB$$

For the case of an inertia line the length $\mathfrak{s}$ is given by the equation:

$$\mathfrak{s}^2=(t_1-t_0)^2-(x_1-x_0)^2-(y_1-y_0)^2-(z_1-z_0)^2.$$

As before, let A, B, C be elements the co-ordinates of which are as follows:

	x	y	z	t
A	0	0	0	0
B	0	0	0	10
C	4	0	0	5

Here AB=10, AC=3, CB=3.

Thus AC+CB<AB.

These examples should be sufficient to give an air of plausibility to my statements. A. A. ROBB.

Cambridge, January 23.

Entente Scientific Literature in Central Europe during the War.

THE chief object of my letter, "A Tribute from Prague," published in NATURE of December 11, 1919, was to congratulate the Editor upon the jubilee number and to express my delight at again being able to obtain this invaluable journal after an interval of more than five years. I thought it worth while to state very briefly that this break was caused by political reasons.

The letter by Mr. Lawson published in NATURE of January 1 induces me, unwillingly, to enter a little into non-scientific details.

There is a decided difference between the point of view during the war of an interned distinguished foreigner enjoying the well-known hospitality of the inhabitants of the capital of the late Austro-Hungarian Empire and that of us Bohemians or Czechs whose country was, by the Government of the same Vienna, nearly converted into a desert, whose best men (even poets) were imprisoned and condemned to death for their regard for the Entente, and who, had the war lasted only half a year longer, would have experienced the same fate as 1,500,000 Slavonic, chiefly Serbian, children in Bosnia and Herzegovina, condemned to starvation. Their parents, in so far as they were not shot down, escaped from death only by eating grass and other herbs!

No Englishman can wonder that we (Austrian) Slavs fully sympathised with the contents of the following two remarkable articles, which I select from a great number:

(1) The leader, "The War and After," published in NATURE of September 10, 1914 (p. 29). Never previously had such a fine political article been published in your columns, and I would beg readers to convince themselves that its great truth, and even prophecy, were fulfilled to the last point.

(2) An article published by Sir Oliver Lodge during the early part of the war in the *Psychological Review*. Sir Oliver says that there exists a Great Justice watching over the destinies of mankind who will never allow a crime to become a law. The editor of our leading daily paper introduced this view as "strange ideas of a spiritualist," and only by this trick did it escape the watchful eye of the censor. I thank Sir Oliver for this article, which kept many of my countrymen and me firm in the days of our greatest distress.

All this was known to the Austrian Government, and it is well understood why it withheld during the whole war the circulation of periodicals which contained such articles as those referred to above.

Towards the end of the war, when everyone saw that the old Monarchy was going to pieces, the Austro-Hungarian Foreign Office—and I assure Mr. Lawson that I am by no means "unaware of the fact"—asked the Senate and professors of our University to fill a circular with the names of the Entente scientific journals which they would like to obtain. I denoted several journals—in the first place, NATURE. I know that those belonging to the "privileged nations" obtained the journals they wished, but no notice at all was taken of my desire or that of any other Bohemian scientific institution up to the very end of the Monarchy.

BOHUSLAV BRAUNER.
Chemical Laboratory, Bohemian University,
Prague, January 20.

Percussion Figures in Isotropic Solids.

ALL anthropologists will be glad to see the subject of percussion figures receiving attention in the pages of NATURE (October 9 and November 20, 1919), as the figures form the basis of flint-fracture—the important factor in determining the age and origin of man. Unfortunately, the fracture cone is by no means so simple and constant in outline as one might be led to expect from what has already been advanced, and a number of factors enter into the question, such as the shape and elasticity of the percusser, the velocity of the blow, the striking angle, the perfection of surface of the percussed, its elasticity, and, above all, its varying refrangibility.

In Nature and practice we generally find that after the cone has maintained itself for a distance, the surface resolves into a cylinder in the striking plane, which is maintained for a certain varying distance; then it resolves outwards in a more conical direction, which may extend until rupture takes place; or it may even resolve again and again as before, giving rise to *step-cones*. Specimens before me show seven such steps. Further, from causes into which we cannot now enter, the well-known conchoidal ripplings may be set up. These may be very simple and concentric or the very reverse, and may be either apical or marginal; they pass into *step-cones*. Frequently the surface turns inwards, producing cylindrical fracture more or less normal to the striking plane.

Generally, with glass and flint there is another set of features in the form of stellate lines, which may be very few or numbered by hundreds. An examination of these shows the cone to be a surface of revolution, and the direction of the gyrations is shown by the steps made by every radial (some dozen of these are faintly shown in Prof. Raman's illustration in NATURE of October 9). These may increase in size until we get *step-fracture*, where the steps may be, say, 3 mm. or 4 mm. high. It may be noted in passing that these are the lines along which fracture in plate-glass takes place.

Perhaps the most remarkable thing about these steps is that they indicate right and left revolutions in relation to the cone. Sometimes the two hemicones coincide, and we get a perfect cone. At other times the fracture-waves overlap for a distance, giving rise to the mysterious *éraillure*; they may also meet in a re-entrant angle, which may become very acute, say down to 30°. This is only the beginning of the complications. Cones may be quite asymmetrical; one hemicone may be reduced to a plane. There are also *faceted cones*, *shell-cones* (*cones in cones*), and *cones in cups*. Then there are the phenomena of *cone-capture*, and still greater complications of positive and negative hemicones, and multiple hemicones which by mutual capture produce large flat surfaces, and many others.

I suggest that the study involves something more than isotropics, seeing that in glass, silica, and many other substances new atomic or molecular re-arrangements set in which soon render them anisotropic or anisoclastic, and in one direction end in spontaneous disruption into forms which call for mathematical explanation quite as much as, and indeed more than, simple percussion figures in ideal isotropes; and, on the other hand, colloids pass into crystals where both optical and dynamical properties vary according to the lines along which the alterations take place.

W. J. LEWIS ABBOTT.
St. Leonards-on-Sea.

Change of Colour in Plumage of Captive "Sun-birds" or "Honey-suckers."

WE have had considerable success at the Zoological Gardens here in keeping in health nine varieties of "sun-birds" or, as locally known, "honey-suckers,"

all of Natal, South Africa. The aviaries are of simple wire-netting, in which are growing flowering shrubs and weeds. Their dimensions are 12×9×6 ft.

The food provided is Mellin's (baby) food, honey, and Swiss milk (tin) in equal proportions, and pea-flour one-quarter to the above.

The brilliant scarlet borne by certain of the varieties has changed in every case to a bright orange colour, thus causing the bird to present a great contrast to its original colour. Metallic green, which is borne by so many of the "sun-birds," is in no manner affected. Other colours of these birds are also not affected.

It would appear to be a case of change of plumage caused by the feeding, for the condition of life is almost natural.

We are not aware of such variety of colour having been observed previously. It would be of interest if any contributor to NATURE could give information of examples of similar occurrences with respect to captive wild birds, or offer an explanation of the physiological causes which are at work.

HAROLD MILLAR,
Director.

Zoological Gardens, Mitchell Park, Durban,
Natal, December 30, 1919.

MATHEMATICS IN THE UNITED STATES.

NOT very long ago (perhaps fifteen or twenty years) an English lady, spending a visit in Utrecht, met a distinguished Dutch professor of mathematics. In the course of conversation the lady asked the professor what he thought of contemporary English mathematicians and their work. The answer was not calculated to flatter our national vanity, for it was to the effect that he rarely looked at English mathematical papers, because they were so unconnected with the general progress of the science, and written in such a peculiar way that he could scarcely understand them. Incredible as it seems, this opinion was expressed when Salmon, Cayley, Sylvester, and Clifford had published all their best work. Prejudices die hard, and the professor's attitude would have been intelligible in the earlier part of the nineteenth century.

One moral of the story is that, as there are nationalities in drinks, so there are in mathematics, in spite of the growing tendency towards universal co-operation. The history of recent mathematical progress in the United States presents many points of interest. To a great extent, American mathematicians may be regarded as the grown-up pupils of Germany. From Germany they have acquired habits of thoroughness, breadth of view, and collaboration. But they have clearly passed the time of pupilage, as we see from their growing list of original and eminent writers; it is enough to refer to such men as the two Peirces and Willard Gibbs.

There are several features of the attitude of the Americans towards mathematics which deserve our careful attention. In the first place, it should be noted that the State and private benefactors encourage mathematics for its own sake, quite apart from considerations of utility. Many American professors are allowed to devote themselves to research in such things as group-theory, abstract geometry of all kinds, function-theory, and the higher arithmetic; the predominance of such subjects in American journals and transactions is quite remarkable. The Government and people of the United States appear to be fully conscious of the fact that special ability of *every* kind should be encouraged.

An excellent American institution, which might well be adopted here, is that of the sabbatical year, which gives the teacher an opportunity of bringing his knowledge up to date, or of carrying out some laborious research. As an example of what can be done in such periods of leisure, we may refer to the recently published first volume of Prof. L. E. Dickson's "History of the Theory of Numbers." With almost incredible industry, the author has personally consulted and summarised thousands of papers, notes, and memoirs; and if the work is carried out on the same scale it will fill four or five large octavo volumes, and be an indispensable guide to all who work in this field. It may be remarked here that we owe to the States many valuable works on the history of mathematics (especially from the teacher's point of view), and reprints and translations of scarce and valuable works.

Collaboration, both in the composition of books and in that of papers, is more common than with us. There are two sides to this question; in some cases the advantages of joint authorship are obvious, but those treatises which rank as masterpieces (such as Salmon's "Conic Sections" or H. Weber's "Algebra") are usually, if not always, the work of one man.

American mathematical colloquia are far more serious affairs than anything we have here. They are meetings of experts, lasting for a week or so, at which a serious programme is carried out, and carefully prepared addresses and short sets of lectures are delivered on topics of outstanding interest. In this matter we ourselves seem to vibrate between two extremes; either we have a technical meeting where papers are read (or taken as read), which seldom interest more than one or two of the audience, or we indulge in a picnic, at which a few casual notes are communicated, mainly for the sake of securing priority.

While thus directing attention to some things in which we might well imitate the States, we have no intention of carping at our own countrymen. The *general* condition of mathematics in this country is probably better now than it has been for many years, and we should be sorry to see some of the old English characteristics disappear. For instance, the view that mathematics is a gentlemanly recreation has something to be said for it, and we may avoid being needlessly solemn and serious in our study of it, however conscious we may be of its vital importance for national welfare.

G. B. M.

SHACKLETON'S LAST ANTARCTIC EXPEDITION.[1]

SIR ERNEST SHACKLETON'S book is an exciting story of a polar expedition that was a disastrous failure in almost everything it set out to do, with a difficult, but stolid and dangerous, retreat and a splendid retrievement. It is of popular rather than of scientific value. To readers of NATURE the last twenty-four pages are of the greatest interest.

The volume shows that medical and science graduates from London, Cambridge, and Aberdeen can be as tough and as useful as the most hardened seamen, and do more than ordinary and A.B. seamen's work on a full-rigged auxiliary steam sailing vessel. Also, that they can sit as tight on a dangerous and rotten piece of ice-floe for month after month, and do good scientific work in squalor and filth and in water in a frozen and thawing condition as well as any, and continue scientific observations and collecting—an example to others making observations and records under more favourable conditions. One and all also served as valuable officers in the fighting Services on their return.

The expedition was under-financed and under-equipped, and there was not enough time given to carry it out successfully. The Weddell Sea alone required two ships and a larger scientific staff, especially in meteorology and biology; there should also have been additional sub-Antarctic meteorological and biological stations or ships. But the Treasury and Parliament are hopelessly blind even now after they should have learned that it was on science that the European War was ended. Science has been found essential on the land, on the sea, and in the air in every way; in the fighting and equipment of the forces, and in the maintenance of non-combatants at home, older men and women and children. The Government was sure of a good leader, and should have given not less than 200,000*l.*, with the guarantee that equipment, ships, small stations, and a sufficient and thoroughly good scientific staff were secured, and that more time was afforded.

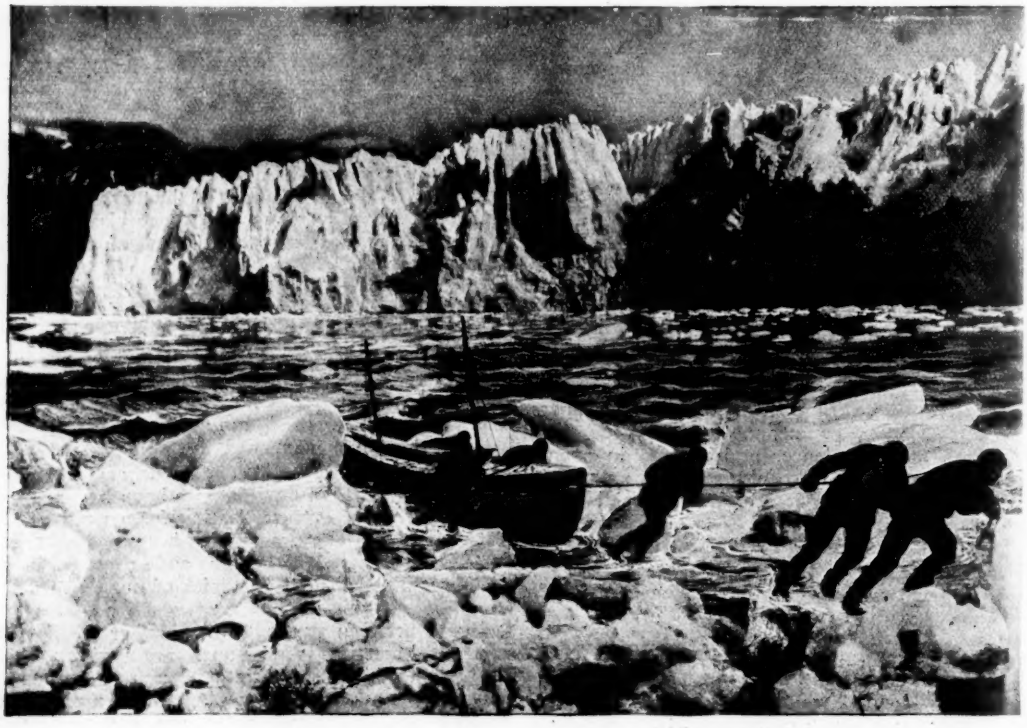


FIG. 1.—Landing on South Georgia. Composite drawing and photograph. From Sir Ernest Shackleton's "South." (W. Heinemann)

The Weddell Sea and South Atlantic have been shown to be huge suppliers of food and of material for the manufacture of explosives. It has been found that the meteorology of those parts is an important factor in the meteorology of the globe, especially in southern agricultural areas upon which we are largely dependent.

One omission is that there is no special acknowledgment to the British Admiralty, which had come in at the bitter end. The Admiralty, with special

[1] "South: The Story of Shackleton's Last Expedition, 1914–17." By Sir Ernest Shackleton. Pp. xxi+376. (London: William Heinemann, 1919.) Price 25*s.* net.

scientific experts and Sir Ernest Shackleton's own representatives, helped the explorer with official assistance to secure the vessels he finally obtained. Even before news of the loss of the *Endurance* came to hand, it had begun the organisation of a relief expedition, and secured and re-conditioned the *Discovery*, which actually sailed so far as Buenos Aires, involving the expenditure of a large sum of public money, better given earlier to the expedition.

The *Endurance* was crushed in approximately 69° S. after being beset off Caird Coast, the south-west coast of Coats Land, whence she drifted west, north-west, and north until she sank. Sir Ernest Shackleton and his party later escaped on floating ice, drifting in a track almost parallel to, but a little west of, the *Deutschland*; and, like the Swedish ship *Antarctic*, the *Endurance* was totally wrecked, and the biological collections and most of the records were unfortunately lost. With the *Deutschland* she thus confirmed the drift of the ice to the west of the Weddell Sea, as originally observed by the *Scotia* and others. She also confirmed the *Scotia's* observations regarding Coats Land and the southern part of the Weddell Sea, and refuted Sir Clement Markham's opinion that it was an open sea from which warm winds drove across by a strait to McMurdo Sound. Sir Ernest Shackleton plainly demonstrated that the reverse was the case, and that heavy and light conditions of ice existed there, calling it "the worst portion of the worst sea in the world," enough to imprison, crush, and lose his ship; but Sir Ernest Shackleton and Capt. Worsley allowed themselves to be too much entangled in it, which probably a veteran ice-master like Robertson would not have done.

Mr. Wordie usefully and ably summarises the scientific work done in the Weddell Sea, and says: "The work undertaken and accomplished by each member was as wide as possible, but it was only in keeping with the spirit of the times that more attention should be paid to work from which practical and economic results were likely to accrue."

FIG. 2.—The last of the *Endurance* before she sank. From Sir Ernest Shackleton's "South." (W. Heinemann.)

He also gives an excellent but too short summary on "Ice Nomenclature."

Mr. Clark proved the faunistic richness of the coastal Antarctic waters, but, unfortunately, all his collections were lost with the ship. Doubtless he has brought home some notes of which we shall hear more in time, for he was already well acquainted with the Weddell Sea fauna. He gives an excellent summary of South Atlantic whales and whaling, which should be particularly useful to the Colonial Office now that it is considering the commercial value of the industry to the Falkland Islands colony and its dependencies.

Mr. Hussey follows with a good summary on the meteorology, but, unfortunately, the valuable

detailed tracings packed in the ship's hold were lost. Mr. Hussey's discussion shows that "January 1915 was dull and overcast, only 7 per cent. of the observations recording a clear blue sky, 71 per cent. being completely overcast." The clearest weather occurred in winter, when the sky was cloudless for nearly half the time. Some interesting results are likely to accrue when the meteorological records are worked up in detail and co-ordinated with other observations from South Atlantic and South American stations. "Temperatures on the whole were fairly high, though a sudden unexpected drop in February, after a series of heavy north-easterly gales, caused the ship to be frozen in, and effectually put an end to any hopes of landing that year. The lowest temperature experienced was in July, when 35° Fahr., *i.e.* 67° below freezing, was reached."

For determining the position in drifting pack ice, Mr. James found the theodolite a more generally useful instrument than the sextant, as the ice-floes were found quite steady in really thick pack ice, and the theodolite can be set up and levelled as well as on dry land. Mr. James shows that "the *Endurance* was carried by the ice-drift well to the west of the Weddell Sea, towards the position of the supposed Morrell Land, so that the accurate determination of longitude became a matter of moment in view of the controversy as to the existence of this land." The existence or non-existence of Morrell Land, however, has yet to be investigated more thoroughly, in spite of the assurance of Sir Ernest Shackleton and others that it does not exist. If it is a low "*cluster of islands*," it would not have been seen at all; the party may have drifted on the floe to the west of it.

Sir Ernest Shackleton's appendix on the lists of provisions and gear in the McMurdo Sound huts is most useful and important for future expeditions.

Finally, the drift party reached Elephant Island, which was one of the places the Admiralty had planned to search. But several landings were made there a century ago, and Sir Ernest Shackleton's expedition is not the first to land there, as he quite excusably supposes. The voyage to South Georgia was a wonderful piece of seamanship and endurance, and Sir Ernest Shackleton has again shown that he can lead men. The story of the *Aurora* with MacIntosh and Stenhouse is another disaster. Spencer Smith unfortunately died while doing land work, which included, however, successful depôt laying, under MacIntosh. The absence of scurvy, on the Weddell Sea side, shows what is possible if fresh meat is mainly adhered to.

MacIntosh and Hayward lost their lives in a blizzard while attempting to cross from Hut Point to Cape Evans on thin ice, and were blown out to sea.

Capt. Stenhouse, of the *Aurora*, handled that vessel with marked ability during her ten months' drift beset in the ice. No mention is made of any systematic scientific work having been accomplished by the Ross Sea party. W. S. B.

TELEPHONING BY LIGHT.

TELEPHONY by means of light is a particular case of wireless telephony. It differs from what is generally understood as wireless telephony in no essential respect. In both cases electromagnetic waves are used, but whereas in ordinary wireless the waves are very long, in the case of light they are very short. As a consequence, telephony by light is easily directed by means of lenses or mirrors, and constitutes a secret means of communication—a state of affairs not yet attained in what is popularly known as Marconi wireless transmission. At the same time, the use of light imposes definite limits on the possible range of light telephony. An uninterrupted straight line is essential between the sending and receiving stations, and the extreme range is therefore determined by the curvature of the earth and the altitudes of the stations.

The transmission of speech by light is rendered possible by the well-known property possessed by selenium (and certain other substances) of changing its electrical conductivity when subjected to varying illumination. Selenium thus acts as a sort of electric valve controlled by light. It is capable of responding to some extent to light

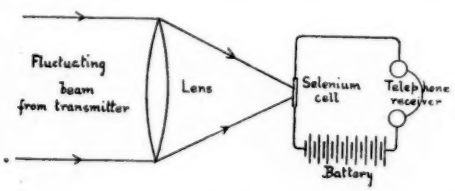


FIG. 1.

fluctuations of comparatively high frequency. If a selenium cell is connected in simple circuit with a battery and a telephone receiver—as shown in Fig. 1—fluctuating currents are obtained possessing the same characteristics as the variations of the incident light, and if the latter are of audible frequency the corresponding sounds are heard in the receiver. The problem of light telephony is thus reduced to the production of a beam of light fluctuating in intensity in accordance with the vibrations constituting the speech sounds.

The construction of the first transmitter of this kind was due to Graham Bell, who in 1880 succeeded in transmitting speech by means of a beam of sunlight over a distance of about 200 yards. Telephony by light is, indeed, almost as old as ordinary telephony, and Graham Bell was the inventor of both. It is difficult to account for the difference in the rate of development of the two systems; the fact remains that ordinary telephony is now in common use, whilst telephony by light is still a novelty. Graham Bell's first photophone—as it was called—consisted of a large diaphragm, silvered so as to become a mirror. Upon this mirror a beam of light was projected and thence reflected to the distant selenium receiver. Speech sounds, falling on the diaphragm, set it in vibra-

tion, thus causing its curvature to change. The result was that the reflected beam became alternately more and less divergent, so that the amount of light incident on the selenium executed fluctuations of the original frequency and amplitude, and the speech sounds were reproduced in the telephone receiver. Other forms of transmitter are also described by Graham Bell, but it is doubtful whether they were actually successful in practice.

Little further work on the subject appears to have been done until about 1900, when Ernst Ruhmer carried out for the German Government a long series of experiments. He approached the problem from a different point of view. Instead of seeking to impose fluctuations of intensity on a beam of light from a constant source, as Graham Bell had done, he arranged to control the brightness of the source itself by means of the vibrations of speech. The sensitive or speaking arc was already known, and Ruhmer improved it for the purpose of light telephony. Briefly, the principle amounts to this. The current in an electric arc controls the brightness of the arc. Variations of current produce variations of brightness. By means of a transformer, the fluctuations of current in a microphone actuated by speech can be introduced into the arc circuit, and thus produce changes of brilliancy corresponding to the speech vibrations. Ruhmer succeeded in perfecting this system, and claims to have communicated speech over several miles by projecting the beam from the fluctuating arc, by means of a searchlight reflector, on to a distant selenium cell.

This method suffers from several disadvantages, of which the chief is that it is limited to the arc as a source of light, and rules out the use of that much more efficient source—the sun. It is difficult also to maintain the arc in the necessary sensitive condition; it requires continual adjustment. It was these considerations which caused the present writer, in working for the British Admiralty on the subject in 1916, to revert to the general method adopted by Graham Bell—namely, to interrupt the light after it had left the source. The essential point which had to be borne in mind was that the vibrations which it is possible to impart by speech to a diaphragm are of very small amplitude—a few thousandths of an inch only. In order to use these vibrations for producing large fluctuations of intensity in a beam of light, magnification is necessary. In the transmitter about to be described, it will be seen that the magnification is optical. There are many possible variations of the apparatus, but the essential features are shown in Fig. 2. Speech sounds enter the trumpet and fall upon the diaphragm of a gramophone sound-box. To the lever of this sound-box, at the place which the needle ordinarily occupies, is attached a small galvanometer mirror. The vibrations of the diaphragm cause this mirror to execute small *angular* oscillations about an axis perpendicular to the plane of the diagram. Light from a suitable source, such as an arc, or, it may be, the sun, is focussed by means of the first lens upon the vibrating mirror; thence it is reflected through the second lens. The focus of this lens coincides with the vibrating mirror, so that the emergent beam is a parallel one.

A grid consisting of equal and parallel strips alternately opaque and transparent is placed close to the first lens, and a second equal grid near the second or projecting lens. The result is that the light from each point of the source is split up into segments indicated by the unshaded portions, and the extent to which the light penetrates the second grid depends on the momentary position of the vibrating mirror. As shown in Fig. 2, about 50 per cent. of the maximum is being projected, but evidently if the mirror turns through a small angle in a clockwise direction the reflected segments will turn also, and the light penetrating the second grid will increase; a counter-clockwise movement of the vibrating mirror will, on the other hand, diminish the light projected.

Thus, in so far as the mirror copies the vibrations of speech, and provided that the amplitude is not allowed to be greater than that corresponding to the width of one space of the grids, a fluctuating beam of the desired character is obtained. It may be projected on to the receiving apparatus shown in Fig. 1 and used for the transmission of speech. By making the width of the grid spaces small in comparison with the distances between the grids and the vibrating mirror, adequate control of the light intensity is secured, even though the movements of the diaphragm are so small. It is, in fact, easy to reach the stage when the grids must be made no narrower, otherwise the amplitude of movement of the segments of light is excessive, and the frequency of interruption becomes doubled or even trebled—to the detriment of articulation in the received speech. It should be pointed out that the diagram shows only the light proceeding from a single point of the source. Actually, every source is finite in size, and in order to provide for this it is necessary to use as the vibrating mirror a *concave* reflector, the radius of curvature of which is equal to the distance between the grids and the mirror. A real image of the first grid is thus obtained on the second, and this image moves in the manner of a shutter when the mirror oscillates.

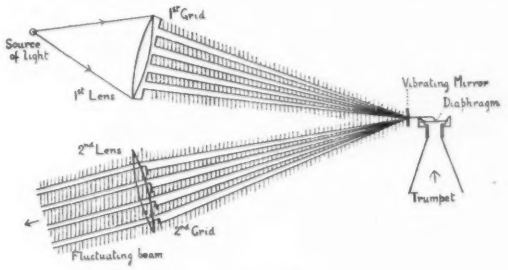


FIG. 2.

Fig. 3 is a photograph of a transmitter arranged for use with sunlight, and mounted so that it can be directed as desired. The lenses are 6 in. in diameter, and the range with sunlight, when a 6-in. collecting lens is also used, is about 8 miles. It is impossible at present to say what the ultimate limit of range may be. It depends on the apertures of the projecting and receiving optical systems, the brilliancy of the source, and the extent to which amplification by means of thermionic valves may be possible in reception. The selenium cells which the author has used were made by Dr. Fournier d'Albe, and they have given very satisfactory results, the articulation of the speech heard being extraordinarily perfect. Their

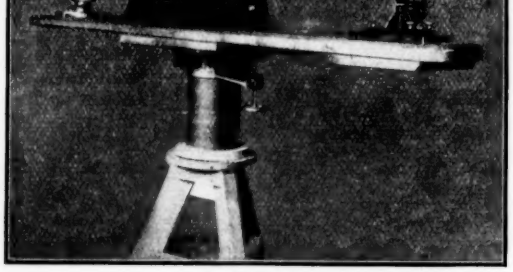


FIG. 3.

special sensitivity to red light perhaps accounts for the fact that a small amount of mist between the sending and receiving stations has been found not to interfere greatly with transmission.

In this short article it has not been possible to give more than a brief description of essential points. Fuller details both of the photophone and of its application to the photographic recording and reproduction of sounds may be found in the Proceedings of the Physical Society of London.[1]

A. O. RANKINE.

AUSTRALIAN RAINFALL AND WHEAT YIELD.

UNTIL large schemes for the conservation of water supply with a view to irrigation have been carried out, the incidence of drought at frequent intervals is bound to have a great influence, not only on the sheep runs of the Australian Commonwealth, but also on its wheat crop. It is perhaps surprising that the relation between rainfall and wheat yield should be to a great extent directly traceable, when we consider to how many indirect influences the yield is exposed. The seed varies in such obvious characteristics as size and hardness, as well as in power of resistance to disease, partly modified by the conditions under which the crop producing the seed has been raised. There is, moreover, no constancy in the soil, which differs from place to place in composition, in aspect, elevation, and slope, from farm to farm in the amount and choice of fertilising agents, and from district to district in the dates of weather changes and precipitation. There is possible loss by barrenness of seed, by ground pests before germination, by vermin during growth, by storms, birds, insects, and disease when the grain is in the ear, and much may be shaken out when ripe if the harvest weather be very hot and dry.

In spite, however, of all these disturbing factors we find from the latest official publication on the subject strong evidence of direct correlation between the wheat yield per acre and the rainfall of the previous winter. For South Australia and the Northern Territory the correlation coefficient works out at 0·61, with a probable error of 0·07. It must be admitted that the data are far from being homogeneous, comparatively few of the stations yielding figures for the whole period. The publication is entitled "Results of Rainfall Observations made in South Australia and the Northern Territory, including all available annual rainfall totals from 829 stations for all years of record up to 1917, with maps and diagrams, also appendices presenting monthly and yearly Meteorological Elements for Adelaide and Darwin" (Green, Acting Government Printer, Melbourne, 1918), and is the fourth of a series. Previous volumes dealt with the Eastern Provinces (Queensland, New South Wales, and Victoria), and two more are contemplated to complete the set by including Western Australia and Tasmania.

There is a wealth of detail contained in the four hundred or so pages, to say nothing of the seasonal maps and diagrams. The territory covered is large, more than 900,000 square miles, and the annual rainfall varies from 4·07 in. at Mulloorina in the centre to 61·37 in. at Darwin in the Northern Territory and 45·91 in. at Stirling West in South Australia. The mean annual rainfall for the Northern Territory (four-sevenths of the whole) is 19·52 in. (thirty-seven years' average), the extremes being 30·28 in. in 1904 and 12·20 in. in 1905. For South Australia the mean is 9·39 in., and the extremes, curiously enough also in consecutive years, 15 in. in 1889 and 5·88 in. in 1888. Of forty-seven counties with a long record, twenty-eight had their driest year in 1914, and twenty-five their wettest in 1916. In quite a large number of districts, accordingly, the wheat yield per acre was lowest in 1914 and highest in 1916. The most conspicuous dry periods were 1895 to 1902 and 1911 to 1915. It may be noted that rainfall was deficient at Greenwich also for each year of the first of these periods, but not for the second.

Conditions at Adelaide, which has the longest meteorological record in the district, are very different from those at Greenwich, but there is some similarity in the rainfall. The wettest day at Adelaide in seventy-seven years was March 5, 1878, with 3·50 in., the number of daily falls

[1] Proc. Phys. Soc., vol. xxxi., p. 242, and paper read December 12, 1919.

of at least an inch being 130. The wettest day at Greenwich in seventy-eight years was July 27, 1867, with 3·67 in., and the number of daily falls of at least an inch was 113.

A much more interesting comparison, however, is afforded by the tables relating to Adelaide in the south and to Port Darwin in the north. Darwin is 11° within the Tropics and Adelaide 11° outside, but while Darwin is on the coast, Adelaide is six miles from the nearest point of the sea. The mean height of the barometer, corrected to sea-level, is 0·225 in. (or nearly 8 millibars) higher at Adelaide than at Darwin, the extreme readings being at Adelaide 29·204 in. and 30·704 in., and at Darwin 29·017 in. and 30·151 in. The temperature contrasts are striking. The mean temperature at Darwin is 82·7° F., with a monthly mean daily range of 16·8°, and at Adelaide 63·0° F., with a mean range of 19·7°. Darwin, being a tropical station, has a range of only 8° F., or rather less, between the warmest and coldest months. Adelaide, on the other hand, has a corresponding range of 22½°. Again, the highest temperatures recorded at Adelaide were 116·3° in the shade and 180·0° in the sun; at Darwin, 104·9° in the shade and 168·5° in the sun. It is therefore not surprising to find that readings of at least 100° in the shade occur much oftener at Adelaide—13·5 per annum, as against 1·6 per annum at Darwin. It is otherwise with readings of at least 90° in the shade, where the annual numbers are 43·6 at Adelaide, and 237, or nearly two days out of three, at Darwin. The lowest reading at Darwin was 55·8°, and at Adelaide 32·0°, for air temperature. Terrestrial radiation readings are not given for Darwin, but a minimum of 22·9° occurred at Adelaide. Darwin also seems to be unprovided with a sunshine recorder, but at Adelaide the annual average is 2531·5 hours, a maximum of 2829·9 hours having been measured in 1898, in which year also the sunniest month occurred, 374 hours being recorded in January.

Many other matters besides rainfall are included in the main part of the volume, as indicated in the following list of tabulations: aurora, bush fires, drought, earthquakes, floods, fog-bows, frost, hail, heat waves, high tides, meteors, mirages, mock moon, plagues and pests and live-stock diseases, heavy rainfall, thunder and lightning, volcanic dust-clouds, water-spouts, hurricanes, cyclones, heavy gales, dust-storms, etc.

W. W. B.

NOTES.

WITH the assistance of the Air Ministry and the co-operation of Messrs. Vickers, Ltd., Lord Northcliffe has been able to arrange, on behalf of the *Times*, for an attempted flight from Cairo to Cape Town, a distance of more than five thousand miles. This journey from one end of the continent of Africa to the other, and traversing country the nature of a large part of which is little known, is of particular interest to the scientific world in view of the fact that Dr. P. Chalmers Mitchell, secretary of the Zoological Society of London, is taking part in it as passenger and observer. The enterprise will thus not only test the practicability of the air route from Cairo to the Cape, but also doubtless lead to valuable scientific observations being made during the flight. The aeroplane left England on January 24 and arrived in Cairo on February 3. The machine is a Vickers-Vimy commercial aeroplane similar to those used for the flights across the Atlantic and to Australia, and it carries a crew of four in addition to the passenger. Dr. Chalmers Mitchell is carrying an autograph letter from the King to Lord Buxton, Governor-General of South Africa, and we hope that he will be able to deliver it in twelve days or so after a successful end to what is a pioneer effort in scientific exploration from the air.

THE *Kew Bulletin* (1919, p. 399) records the appointment by the Government of South Africa of an Advisory Committee to carry out and supervise a Botanical Survey of the territories included in the Union. Dr. J. B. Pole-Evans, chief of the Division of Botany in the Department of Agriculture, will act as Director of the Survey, and he will be assisted by a small committee, including several prominent South African botanists and representatives of Government Departments interested. The objects of the survey are to continue and extend the work of the Division of Botany on the systematic study of the vegetation of the country and of the plant parasites of the indigenous vegetation; that of the Division of Veterinary Research on the relation of the vegetation to stock diseases; and that of the Forestry Department on the composition of the indigenous forests, the value of their products, and their industrial possibilities. Also to study the vegetation from the various points of view of industry, agriculture, and pastoral development; to study plant distribution and the influence of South African conditions on the structure and physiology of the native plants; and to compare and correlate the South African flora and its associated animal and plant diseases with those existing in other parts of the world under somewhat similar conditions. For the purpose of the survey the country will be divided into a convenient number of areas each under the control of a botanist, and a qualified assistant has been appointed at Kew to aid in the critical examination of the plants collected.

BY a melancholy coincidence the announcement of the appointment by the Egyptian Government of an International Commission to consider the proposals for the extension of irrigation works in Egypt and the Sudan is followed by the news from Bombay of the death of Sir Michael Nethersole, who had been selected for the chairmanship of the Commission, but had felt impelled to decline the offer by reason of the claims of his work in India. Born in 1859, Sir Michael passed in 1880 from the Royal Indian Engineering College at Coopers Hill into the Public Works Department, and, rising through the grade of executive engineer, he became in 1900 Chief Engineer and Secretary to Government in the United Provinces. In this position he remained for a dozen years until

his appointment as Inspector-General of Irrigation in India. He retired in 1917 with a knighthood, having been created C.S.I. in 1914. Retirement from public service, however, was only followed by professional activity of another kind, and until his death Sir Michael occupied the position of chief hydro-electric engineer to the Tata Co. at Bombay, under the auspices of which he recently completed the tunnelling work for the Andhra Valley scheme of water-power.

WE regret to announce the death on February 1, in his seventy-ninth year, of Mr. C. E. Groves, F.R.S.

DR. W. MCDOUGALL, Wilde reader in mental philosophy in the University of Oxford, has been elected president of the Society for Psychical Research, in succession to the late Lord Rayleigh.

SIR DANIEL HALL, K.C.B., F.R.S., Permanent Secretary of the Board of Agriculture, has been elected a member of the Athenæum Club under the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public service."

SIR NORMAN MOORE, president of the Royal College of Physicians, has appointed Dr. F. W. Andrewes to be Harveian orator and Dr. R. C. Wall to be Bradshaw lecturer for this year. The council has appointed Dr. Martin Flack to be Milroy lecturer for 1921, and the Censors' Board has awarded the Oliver-Sharpey prize for 1920 to Prof. Emil Roux, of the Pasteur Institute, Paris.

PROF. E. B. TITCHENER, Cornell University, Ithaca, N.Y., informs us that the prize of 100 dollars offered for the best paper on the availability of Pearson's formulæ for psychophysics (NATURE, vol. xcii., p. 508, January 1, 1914) has been awarded to Dr. Godfrey H. Thomson, of Armstrong College, Newcastle-upon-Tyne, for a paper entitled "On the Application of Pearson's Methods of Curve-fitting to the Problems of Psychophysics."

Symons's Meteorological Magazine came to an end with the January number, which completed vol. liv. This month it will appear as the *Meteorological Magazine*, with which the *Meteorological Office Circular* will be incorporated. In order to preserve the continuity, the new magazine will be issued as No. 1, vol. lv. The editors will be Mr. Carle Salter and Mr. F. J. W. Whipple. The change is the outcome of the British Rainfall Organisation becoming part of the service of the Meteorological Office.

THE death is announced, in his fifty-second year, of Mr. Robert Hollister Chapman, who had been connected with the U.S. Geological Survey since 1880, with the exception of the period from 1909 to 1912, during which he was engaged on topographical work in Canada. Mr. Chapman made extensive explorations in the principal Western and Southern States, and was the author of maps of Death Valley and adjacent deserts and of the high Sierras. He was secretary of the American Alpine Club. His published work includes many articles and bulletins on topographical subjects, and a book entitled "Personal Explorations in the Northern Selkirks."

THE Elizabeth Thompson Science Fund has been serviceable for many years in giving aid, by small grants, to research which otherwise might not be readily undertaken. The grants are made only for scientific investigations, and must be applied to actual expenses of the research, *i.e.* they are not made to support an investigator or to meet the ordinary expenses of publication. The trustees give preference to researches involving international co-operation. The grants are not made for researches of narrow or merely local interest, nor are they available for the equipment of private laboratories or for the purchase of apparatus ordinarily to be found in scientific institutions. Applications for grants from this fund should be made to Prof. W. B. Cannon, secretary of the trustees of the fund, Harvard Medical School, Boston, Mass.

THE Secretary of State for the Colonies has appointed a Committee to consider whether the staffs of the Veterinary Departments in the various Colonies and Protectorates are adequate, and, if necessary, to recommend increases of staff; to consider whether the rates of salary offered to the veterinary staff are adequate, and, if necessary, to suggest improvements; and to make recommendations for improving the arrangements for recruiting veterinary staffs for the Colonies and Protectorates. The members of the Committee are:—Sir Herbert Read, K.C.M.G., Assistant Under-Secretary, Colonial Office; Sir J. M'Fadyean, Principal of the Royal Veterinary College, London; Sir S. Stockman, Chief Veterinary Officer, Ministry of Agriculture; the President of the Royal College of Veterinary Surgeons; Prof. O. C. Bradley, Principal of the Royal (Dick) Veterinary College, Edinburgh; Prof. J. Share-Jones, Director of Veterinary Education and Professor of Veterinary Anatomy, University of Liverpool; and Major R. D. Furse, Assistant Private Secretary (Appointments), Colonial Office. Mr. A. Cooke, of the Colonial Office, is secretary of the Committee.

IN *Folk-lore* for December last (vol. xxx., No. 4) Dr. W. Crooke discusses the cults of the mother goddesses in India, in the hope that these may throw some light on their somewhat obscure sister goddesses in the West. The cult of Mother Earth prevails widely in India. Beginning with the type of a local fertility spirit of the village, she rapidly becomes anthropomorphised, and is supposed to enjoy a periodical rest after her labours, and to be strengthened for her benign offices by a sacred marriage with a male consort and by animal sacrifice. But in the Vedas and in the later Brahmanical Hinduism goddesses play only a subordinate part. It is among the Dravidians of Southern India that the goddess cult attains its highest development. The Earth Mother is no doubt the parent in India of many of the local goddesses, but it is going too far to assume, as some writers on the mythology of the West have done, that goddess-worship in general originated in the Earth Mother culture. Even in India many of the local goddesses come from the pre-agricultural stage, the Jungle Mothers, or they are the deified spirits of women who died in some heroic way.

LITTLE has hitherto been known about the Stone ages in Ceylon, but the first steps towards a solution of the problem have been taken in a paper by Mr. E. J. Wayland, late Assistant Mineral Surveyor to the Government of Ceylon, published in *Spolia Zeylanica* (vol. xi., part 41, 1919). In opposition to other authorities, Mr. Wayland believes that there is no evidence that the Veddas passed through a Stone-age phase in Ceylon; they are assumed to be immigrants from the Indian peninsula, and the Palæolithic age dates from a period long antecedent to their arrival in the island. The Ceylon implements fall into two groups, that of the hills and that of the lowlands. Pigmy flints are abundant, and the author believes that they were used mainly in boring bone needles. The Chellean type is represented by the hand-axe, the Mousterian by scrapers, and the Aurignacian by pointed implements with edge trimming. An important feature of this paper is the correlation of the various types with the local geological features. Mr. Wayland has given a good introductory sketch of the subject, and by means of his large collection, which, however, needs much addition, the problem of the Stone ages in Ceylon, where the material is abundant, seems to be approaching a solution.

WE welcome the reappearance of *The Mariner's Mirror*, the journal of the Society for Nautical Research. Mr. T. Sheppard contributes an article on the Hull whaling trade, once of great importance, from which the present great fish and oil trades may certainly be said to have developed. Mr. C. Pickering has made a fine collection of objects connected with the business, and presented a large museum devoted to the fishing industry. Mr. Sheppard in his article describes and illustrates many interesting exhibits—"flensers" for cutting the blubber into strips; the seal picks used by men working in masses of ice; a wrought-iron gun-harpoon bent by the speed with which the whale dragged the boat after it; one of the old explosive harpoons, known as Balchim's patent; and harpoons and gun-spears, with a collection of old guns. He also reprints an interesting journal describing the wreck of the whaler *Thornton*, which was lost in 1821. The city of Hull is honourably distinguished for the zeal and enterprise shown in the preservation of relics of its former industries.

DR. J. W. H. HARRISON has tested the effect of alcohol on a Geometrid moth, *Selenia bilunaria*, and finds the resulting offspring superior in many respects (*Journal of Genetics*, vol. ix., No. 1). In broods from treated parents the development was quicker, the mortality lower, and the mean weight of the pupæ greater. This is in agreement with Prof. Pearl's studies of the effects of alcohol on fowls, and is to be interpreted as the result of elimination of the weaker germs and individuals. The offspring from a cross between a treated male and an untreated female was superior to that from the reverse mating. Contrary to expectation, it was found that treatment with alcohol did not lead to the production of germinal variations.

IN a valuable discussion of phylogenetic degeneration in the ostrich (*Journal of Genetics*, vol. ix., No. 2), Prof. Duerden, who is in charge of ostrich-breeding investigations in South Africa, concludes that over its whole continental range this bird has long been undergoing progressive degenerative changes. The toes have undergone gradual reduction as in the horse, until of the original five only the third and a much reduced fourth remain. Even the third, which is the functional toe, shows signs of further reduction. Similar retrogressive tendencies are found in the structure of the wing and in many features of the plumage. These changes are looked upon as orthogenetic in nature, pursuing a continuous course independent of natural selection or adaptation, and certain to lead ultimately to the extinction of the species. In certain cases well-marked steps in variation are taken, as in the bald spot of the North African ostrich, which behaves as a Mendelian dominant character, and is believed to have originated as a mutation. On the other hand, reduction in the wing-coverts and in the scutellation of the toes is a more gradual process, occurring by a series of steps. Contrasted with this is the down of the legs, which begins to disappear when each chick is about six months old, and is thus an ontogenetic phenomenon. In all these cases it seems clear that the seat and origin of the change is in the germ-plasm. The point of view arrived at agrees in many respects with that of Whitman (see NATURE of January 29, p. 566) concerning orthogenetic evolution in pigeons.

THE first part of a "Flora Arabica," by Prof. Ethelbert Blatter, is issued as vol. viii., No. 1, of the Records of the Botanical Survey of India. Prof. Blatter's work on the Indian flora, and more recently on the flora of Aden, renders him especially well equipped for the systematic study of the botany of Arabia, and he has been able also to work through the rich collections at Kew and the British Museum (Natural History). He divides the area into four natural botanical regions—the extra-tropical west, the tropical west, the tropical east, and the extra-tropical east or Persian Gulf region. Part i. comprises a systematic list of thirty-eight families of dicotyledonous flowering plants, the arrangement adopted being that of Bentham and Hooker's "Genera Plantarum." The habitats and general distribution of each species are recorded, also the vernacular names and, where known, the uses of the plants. The chief elements of the flora are the Mediterranean and North African desert.

WE learn from the *Geographical Journal* for January (vol. lv., No. 1) that a new topographical map of New Zealand is in course of publication. The basis of the map is a triangulation, which already existed for cadastral surveys, supplemented by a secondary triangulation. The new map is on a scale of 1/125,000, with contours at 100-ft. intervals, and hill-shading in neutral tint. Roads, water, and wooded lands are shown in colour.

THE rainfall over England in 1919 was nearly everywhere in excess of the average, according to an article in *Symons's Meteorological Magazine* for January

(vol. liv., No. 648). The excess was nowhere large, exceeding 10 per cent. only in scattered patches across the southern Midlands, and reaching 20 per cent. apparently only in parts of Leicestershire. North Wales had a 10 per cent. excess, but in South Wales the summer and autumn drought resulted in many places in a 10 per cent. deficiency. Parts of the east and north of Scotland, notably northern Aberdeenshire and the Orkneys, had more than the average fall, but in central and southern Scotland there was a deficiency culminating in 20 per cent. below the average in central Inverness-shire and Perthshire. Almost the whole of Ireland had less than the average rainfall, the deficiency being greatest in counties Cork, Galway, and Kerry, where it reached 20 per cent. below the mean. Taking the British Isles as a whole, the year, although by no means exceptional, was probably the driest since 1908—a result largely due to the shortage of rain in summer and autumn.

COL. J. TILHO announced some important discoveries in the Sahara in a paper read before the Royal Geographical Society on January 19. The Tibesti highlands prove to be an enormous triangular massif twice the area of Switzerland, with summits more than 10,000 ft. in height. Emi Kussi, the culminating point of the region, is the largest of a series of extinct volcanoes. This volcano has a well-formed crater, which in the past was occupied by a lake, but now has a thick deposit of sodium carbonate on the floor. The population of Tibesti is considerable, and is devoted to camel-rearing and brigandage. Col. Tilho claims to have disproved the possibility of former river connection between Lake Chad and the Nile. His explorations show an extension of the highlands formerly known to occur between the southern borders of Tripoli and Darfur. With regard to the economic development of the Sudan and the Sahara, Col. Tilho advocates an east-and-west transcontinental railway. That this would facilitate the pilgrimage to Mecca is an important consideration for great Mohammedan Powers like Britain and France.

DR. G. F. KUNZ, the well-known authority on the subject of jewelry in all its aspects, contributes to *Mineral Industry* (New York: McGraw-Hill Book Co., Inc.; London: Hill Publishing Co., Ltd., 1919, vol. xxvii., pp. 604–28) his customary chapter on the production of precious stones for the previous year. It may be remarked that this annual volume is written from the point of view of the United States. Rather more than two-thirds of this chapter is devoted to diamond, pre-eminently the precious stone. The jewelry trade is such a sensitive barometer of general trade conditions that we are not surprised to read that the incidence of heavy war expenses and the increase in taxation had sensibly checked the import of precious stones into the United States in the year 1918; the initial figures for 1919 show, however, that the setback was only temporary. We note that in the United States, just as in this country, successful attempts appear to have been made to develop the diamond-cutting industry. We are told that the output of gem material in the Rangoon district of Burma for the year 1917, which is the latest year dealt with, was of much higher value than that of the previous year, although the quantity produced was slightly less. The jade output in North Burma, which is wholly exported to China, where it is highly prized, remains as prosperous as ever. The United States does not produce much gem material, what there is being confined mainly to ruby, sapphire, turquoise, quartz, and tourmaline, although diamonds are being mined in Arkansas.

IN a paper on the factors controlling climate, which appears in the December, 1919, issue of the Journal of the Franklin Institute, Prof. W. J. Humphreys, of the United States Weather Bureau, discusses the theories which have been propounded to account for the existence in the past of "Ice ages," which, after enduring for a time, were succeeded by long periods during which the conditions were again normal. Solar variation, eccentricity of the earth's orbit, and carbon dioxide in the earth's atmosphere are shown not to be capable of affording satisfactory explanations, while the presence of volcanic dust in the atmosphere for any considerable period is proved to be capable of accounting for a fall of temperature of a few degrees Centigrade. The finest dust from Krakatoa probably reached an altitude of 40 to 80 km., and took nearly three years to fall through the isothermal layer of the atmosphere to the level of the upper clouds. If the coefficient of absorption of solar radiation by the dust is greater than its coefficient for terrestrial radiation, the value of the pyrheliometric constant will be diminished. The author shows that there is abundant evidence of this diminution after every considerable volcanic eruption.

AT the meeting of the Illuminating Engineering Society on January 27 a discussion on colour-matching by natural and artificial light took place. Mr. L. C. Martin, in opening the discussion, gave a summary of existing methods of producing artificial daylight. One of the most convenient devices has been the use of a special tinted glass transmission screen used with electric incandescent lamps to remove the excess of red and yellow rays. With the gas-filled lamp the efficiency of such units is considerably improved, 33 per cent. being claimed for a sunlight unit and 19 per cent. when light from the blue sky is imitated. A communication from Mr. M. Luckiesh, read later in the evening, showed how widely such units are being used in the United States. Mr. Martin exhibited the Sheringham daylight lamp, and explained that the overall efficiency of the blue-sky unit was not widely removed from that obtained with similar units using blue transmission screens. On the other hand, the diffusion of the light from the extensive coloured reflector surface used with the Sheringham lamp is considered a distinct advantage. Mr. Martin also showed some very striking colour changes in dyed fabrics seen successively under artificial daylight and light from a tungsten lamp. Mr. Bawtree exhibited a form of colorimeter for the analysis of colour, and Miss F. E. Baker, in showing the tintometer testing apparatus, also described some experiments on a new form of daylight lamp. A communication from Prof. Gardner, of Bradford Technical College, was also read. The production of artificial daylight is exciting keen attention, and several

speakers emphasised the need for a systematic comparison of the various existing units and the establishment, if possible, of a standard of so-called "white" light.

WHILST the chemistry of gelatin has been investigated with much care, less attention has been given to that of glue. Both gelatin and glue are hydrolytic products of the collagen present in hides, but they represent different phases of the hydrolysis, and the details of the manufacture of glue have largely been kept secret. Crucial points are, first, the stage at which the process of hydrolysis must be stopped and the degree of concentration necessary in order to obtain a glue solution which will "set" to a jelly; and next, the method of drying this jelly into the finished glue. A low temperature has been considered necessary for successful drying, and also for avoiding bacterial action during the process. Hence the making of glue in warm countries, such as India, has hitherto not been found practicable. A paper by Mr. K. C. Srinivasan, of the Department of Industries, Madras ("The Manufacture of Glue in the Tropics"), describes how the foregoing points have been investigated by the Department, and the difficulties overcome. It is claimed that by a study of the chemical principles involved, and by laboratory and factory experiments, the details of manufacture have been successfully adapted to the climatic conditions prevailing even in the hottest parts of India.

MR. D. BROWNLIE gives some further exact data on the running of steam-boiler plants in *Engineering* for January 16. The subject dealt with is that of steam jets under or over the fire-bars, and out of the 250 typical steam-boiler plants examined no fewer than 93 plants, or 37 per cent., were fitted with steam jets. The makers of the various types of furnaces so fitted confess, as a rule, to a modest 1 to 3 per cent. of the steam production being used in the jets. Mr. Brownlie finds that the average steam consumption for the 93 plants is 5·6 per cent. of the total steam produced, and that the figure varied from 1 to 20 per cent. In the present article the results derived from 130 plants are considered, including 437 boilers both hand- and mechanically-fired. The averages are 6·6 per cent. for hand-firing and 6·7 per cent. for mechanical-firing. The lowest figure was 0·50 per cent., and the highest 21·4 per cent. If a given plant were taken in hand and scientific methods of control adopted, figures like 7½ to 15 per cent. of the steam production could be cut down to 3 or 4 per cent. with most types of steam-jet apparatus. Some of the apparatus in use is of crude and unscientific design, and incapable of giving good results. Mr. Brownlie estimates that a saving for the whole country of from 1,025,000 to 1,345,000 tons of coal per annum could be effected, partly by proper control and partly by getting rid of steam jets working under unsuitable conditions.

MESSRS. H. K. LEWIS AND CO., LTD., 136 Gower Street, W.C.1, have just issued a list of secondhand books (many of which are from their circulating library) in medicine and allied subjects which should be seen by all in search of books of this character at bargain prices. The reductions in many cases are very great. Messrs. Lewis have also sent us a list of the new books and new editions added to their medical and scientific circulating library during the months October to December last.

Messrs. Cassell and Co., Ltd., promise for February a book of travel by Sir Martin Conway entitled "Mountain Memories: A Pilgrimage of Romance," illustrated by the author. The new list of *Messrs. Constable and Co., Ltd.*, includes "Elementary Mathematics," H. E. J. Curzon; "Electric Welding and Welding Appliances," H. Carpmael (*Engineer* Library); "Paper-making and its Machinery," T. W. Chalmers (*Engineer* Library); "Calculation of Electrical Conductors," W. T. Taylor; "Low Grade and Waste Fuels for Power Generation," J. B. C. Kershaw; "Reinforced Concrete Diagrams," J. Williamson; "The Measurement of Steady and Fluctuating Temperatures," R. Royds; "Heat Transmission," R. Royds; "The Efficiency of Pumps and Ejectors," E. C. Bowden-Smith; "Oil-Firing for Kitchen Ranges," E. C. Bowden-Smith; "Storing," H. B. Twyford; "Public Health Chemical Analysis," R. C. Frederick and A. Forster; "Human Psychology," H. C. Warren; "Wild Creatures of Garden and Hedgerow," F. Pitt; and new editions of "The Propagation of Electric Currents in Telephone and Telegraph Conductors," Prof. J. A. Fleming; "The Theory of Electric Cables and Networks," Dr. A. Russell; and "Ship Form Resistance and Screw Propulsion," G. S. Baker.

THE February list of *Messrs. Longmans and Co.* contains announcements of many books relating to science and education. Among those not already alluded to in NATURE we notice "The Valuation of Mineral Property," Sir R. A. S. Redmayne and G. Stone; "Cement," B. Blount; "Plantation Rubber," G. S. Whitby; and "Margarine and Butter Substitutes," W. Clayton (Monographs on Industrial Chemistry); "The Principles and Designs of Printing Telegraph Systems and Mechanisms," H. H. Harrison; "Telephone Exchanges: Automatic Equipment," B. O. Anson; "Telephone Exchanges: Manual Equipment," H. S. Thompson; "Subscribers' Telephone Equipment," H. S. Thompson; "Overhead Construction," J. W. Atkinson; "Underground Construction," A. O. Gibbon; "Inland Telegraph and Submarine Cable Office Equipment," E. Lack; "Railway Telegraphs," C. W. Slingo; and "Testing of Lines, Apparatus, and Material," F. L. Henley (Manuals of Telegraph and Telephone Engineering); "Applied Naval Architecture," W. J. Lovett; "Industrial Administration," a series of lectures by B. S. Rowntree, T. H. Pear, A. E. Berriman, Dr. J. M. Legge, Prof. L. Hill, T. B. Johnstone, and St. George Heath; "Forage Crops in Denmark," H. Faber; "The Fireman's Handbook and Guide to Fuel Economy," C. F. Wade; "An Essay on Mediæval Economic Teaching," G. O'Brien; and a new edition, in two parts, of "Optical Projection: A Treatise on the Use of the Lantern in Exhibition and Scientific Demonstration," Lewis Wright, rewritten by his son, R. S. Wright, part 1, illustrated.

OUR ASTRONOMICAL COLUMN.

COMETS.—The object announced last week as comet 1920*a* appears to be a minor planet. It was so described by the discoverer, but through some telegraphic confusion was reported as a comet.

Two comets were discovered in December. The first, 1919*f*, was recorded on two plates taken on December 10 at Bergedorf, Hamburg, by Dr. Baade. It is probably identical with Holmes's comet, for which a search ephemeris had been calculated. If so, perihelion passage occurred about November 22.

Comet 1919*g* was discovered by Mr. J. F. Skjellerup at the Cape of Good Hope on December 18, and was also observed by Mr. Woodgate at the Cape Observatory. Dr. Halm sends the following provisional elements:

$$T = 1920 \text{ January } 2{\cdot}674 \text{ G.M.T.}$$
$$\omega = 276^\circ\ 35'$$
$$\Omega = 315^\circ\ 36'$$
$$i = 123^\circ\ 10'$$
$$\log q = 9{\cdot}47376$$

The elements bear some resemblance to those of the comet of 1797, also to 1808 I.

Ephemeris for Greenwich Midnight.

		R.A.	S. Decl.	Log r	Log Δ
		h. m. s.	° ′		
Feb.	10 ...	20 31 52	4 34 N. Decl.	0·0189	0·2869
	20 ...	20 34 28	0 7	0·0934	0·3095
March	1 ...	20 36 8	4 29	0·1541	0·3245
	11 ...	20 36 42	8 43	0·2049	0·3337

The comet is now rather close to the sun, but should be visible in the morning in March.

THE MOTION OF THE MOON.—Dr. J. K. Fotheringham contributed a paper on this subject to the Royal Astronomical Society in January. He showed, as others have done, the necessity for applying an empirical term to the moon's longitude, and the impossibility of determining both that term and the value of the secular acceleration from modern observations alone. Accordingly, various periods were assumed for the empirical term, and the corresponding values of the acceleration deduced. The period 254 years is preferred, as this gives the same value 10″ for the acceleration as that deduced from ancient eclipses. Prof. Turner had found a period of about 240 years from a discussion of Chinese earthquakes and Nile floods. It was suggested that the two periods might be identical, and that the apparent oscillation in the moon's motion was really a change in the earth's period of rotation.

The observations used extend to the end of 1918, ten years later than those used by Drs. Brown and Cowell. These additional observations have considerable influence on the result.

STARS OF HIGH VELOCITY.—In most studies of stellar motions the stars with abnormally high velocities are excluded, which is doubtless a sound principle. Nevertheless, an examination of these motions is of great interest, and was undertaken by Messrs. W. S. Adams and A. H. Joy (Proc. Nat. Acad. Sci., Washington, July, 1919). The highest velocity in space found for any star is 494 km./sec. for the 9th mag. star A.G. Berlin 1366. On the average, the two components of the velocity in the galactic plane are about equal, and 2½ times the component perpendicular to the plane. Nearly a hemisphere in galactic longitude is devoid of apices, the values all lying between 131° and 322°. The centroid of the thirty-seven stars examined has a velocity exceeding 74 km./sec., almost exactly in the galactic plane. These facts seem to establish that the velocities have been generated within our own star system, and that the stars are not mere visitors from outside, as has sometimes been suggested. They are probably mostly of small mass, but this can scarcely be the case with Arcturus, the high velocity of which remains an enigma. It is noted that twenty-six out of the thirty-seven stars are of spectral types F and G.

THE ST. LOUIS MEETING OF THE AMERICAN ASSOCIATION.

THE seventy-second meeting of the American Association for the Advancement of Science was held in St. Louis, Mo., on December 29 to January 3, under the presidency of Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, New York City. The meeting was a most successful one, the attendance of scientific men reaching approximately twelve hundred. St. Louis is the fourth city of the United States in size, and is an extremely progressive centre, paying much attention to educational matters and possessing two universities, two admirable medical schools, an academy of science, the great Missouri Botanical Gardens, and an extraordinarily advanced system of institutions for secondary education. All the meetings (and there were thirty-two distinct organisations meeting at the same time, twelve of them being sections of the association) were held in the single building known as the Soldan High School. In this building there are very many large lecture-rooms with lantern and laboratory facilities, one auditorium with a seating capacity of more than two thousand, and a dining-room with about the same accommodation, and thus the necessity of meeting in distinct and sometimes widely separated buildings, as has occurred in other cities, was avoided.

The opening session was held on Monday night, December 29. Chancellor Hall, of Washington University, St. Louis, delivered an address of welcome, and the retiring president, Prof. John Merle Coulter, gave his address (published in NATURE of January 29, p. 581) on "The Evolution of Botanical Research."

On the following night a lecture, complimentary to the citizens of St. Louis, was delivered by President Simon Flexner on the general subject of the medical outlook in research. The trend of the address was optimistic, and the subjects especially mentioned were influenza, yellow fever, poliomyelitis, and cancer.

During the week addresses by chairmen of sections were delivered as follows:—Section A, "Recent Progress in Dynamics," George D. Birkhoff; Section B, "Some Aspects of Physics in War and Peace," Gordon F. Hull; Section D, "Science and Modern Engineering," Ira N. Hollis; Section E, "Geology as Taught in the United States," David White; Section H, "The Relations of Anthropology and Psychology," Ales Hrdlička; Section I, "New After-the-War Phases of Practical Pan-Americanism," John Barrett; Section K, "The Untilled Fields of Public Health," C. E. A. Winslow; Section L, "The Part Played by Heredity and Maturity as Factors Conditioning the Effects of Training," Stuart A. Courtis; and Section M, "The Organisation of Research," Henry P. Armsby.

There were also a number of symposia, which attracted much attention, as follows:—"World Standardisation" and "Education and Practical Work on the Metric Basis," under the auspices of the American Metric Association; "The Life-cycle in Insects," under the auspices of the Entomological Society of America; "The Relation of the Use of Power and Labour-saving Machinery to Agricultural Progress," under the auspices of Section M; "The Adjustment of Agricultural Teaching and Research

to Changing Conditions," under the auspices of the Society for the Promotion of Agricultural Science; and "The Effects of the War upon Experimental Medicine and Physiology," under the auspices of Section K.

It was an important meeting from the point of view of association business, since the revised constitution was adopted, a copy of which has been published in the journal *Science*. The principal changes in the constitution which will be of interest to members of the British Association are the raising of the annual dues from three dollars to five dollars and of the life-membership fee from fifty dollars to a hundred dollars, the re-lettering of some of the old sections and the adding of new sections. The old Section A, *Mathematics and Astronomy*, has been divided, and A is now *Mathematics* and D *Astronomy*. The old Section H, *Anthropology and Psychology*, has been divided into two sections: H, *Anthropology*, and I, *Psychology*. *Social and Economic Science* becomes Section K; the Section of *Engineering* becomes Section M, and that of *Medical Science* Section N; *Agriculture* becomes Section O, and *Education* Section Q. The titles of the old Sections F and G, namely, *Zoology* and *Botany*, have been changed to *Zoological Sciences* and *Botanical Sciences*. Two new Sections—I, *Historical and Philological Science*, and P, *Manufactures*—have been established, although they will not be organised at present.

The work of the old office of the permanent secretary has been divided, and it has been arranged that a general secretary shall take charge of all features of organisation, while the permanent secretary shall be simply an executive officer to have charge of meetings and of the current finances of the association.

Chicago was chosen for the place of the next annual meeting during holiday week 1920–21, and a schedule of future meetings was tentatively drafted as a guide for affiliated societies in forming their plans for future meetings. This tentative programme includes Toronto or Buffalo for 1921–22, Boston for 1922–23, Cincinnati for 1923–24, and Washington for 1924–25. The Chicago meeting next year will be one of the large fourth-year meetings, that in Washington in 1924–25 being another of these specially large meetings. It is hoped that all the affiliated societies, and, in fact, all scientific men in America who can do so, will make a special effort to attend these fourth-year meetings, and that men of science from other countries also will be able to attend.

Arrangements were made for the establishment of geographical branches of the association and for the affiliation of State and city academies of science.

The newly established American Meteorological Society and the Southern Educational Society were admitted to affiliation.

A committee on international auxiliary languages was authorised to co-operate with a corresponding committee of the British Association and with the International Research Council.

The following affiliated societies met with the association:—American Mathematical Society, Mathematical Association of America, American Physical Society, American Meteorological Society, Society for Promotion of Engineering Education, Association of American Geographers, National Council of Geography Teachers, American Society of Zoologists, Entomological Society of America, American Association of Economic Entomologists, American Nature-Study Society, Botanical Society of America, American Phytopathological Society, American Pomological Society, Ecological Society of America, American Society for Horticultural Science, Association of Official Seed Analysts, Society for Promotion of Agricultural Science, American Metric Association, and Wilson Ornithological Club.

The election of officers by the general committee resulted in the selection of Dr. L. O. Howard, of Washington, as president for the coming year. The following vice-presidents (chairmen of sections) were elected: Section A—D. R. Curtis, Northwestern University; Section B—J. C. McLennan, Toronto University; Section C—S. W. Parr, University of Illinois; Section D—Joel Stebbins, University of Illinois; Section E—Charles Schuchert, Yale University; Section F—J. S. Kingsley, University of Illinois; Section G—R. H. True, Bureau of Plant Industry, Washington, D.C.; Section H—G. B. Gordon, American Museum of Natural History, New York; Section I—E. K. Strong, jun., Carnegie Institute of Technology, Pittsburgh; Section M—C. L. Mees, Rose Polytechnic Institute, Terre Haute; Section N—J. Erlanger, Washington University, St. Louis; and Section Q—C. H. Judd, University of Chicago.

The election of the chairmen of Sections K, L, O, and P was deferred for the present. Prof. E. L. Nichols, of Cornell University, was elected general secretary, and the selection of a permanent secretary to succeed Dr. Howard, who has held office for twenty-two years, was referred to the council, with power to act.

PIONEERS IN THE SCIENCE OF THE WEATHER.[1]

THE year 1919 will be memorable in the annals of meteorology. It witnessed the completion of the process of co-ordination of the national meteorological work in the operations of a single institution by the incorporation of the work of the British Rainfall Organization with the Meteorological Office. Beginning with the meteorology of the sea alone in 1854, when it was a department of the Board of Trade, in 1867, after FitzRoy's death, the Office undertook the mapping and the study of the daily sequence of weather, and on that account was placed in charge of a director with a "grant in aid" from Parliament under the control of a committee appointed by the Royal Society. In 1879, under a directive council, also appointed by the Royal Society, it became generally responsible for the publication of the national contribution of climatological data in accordance with an international scheme laid down by the Meteorological Congresses of Vienna in 1874 and Rome in 1879. In discharge of this duty it was authorised to obtain the aid of the Royal and Scottish Meteorological Societies and of the British Rainfall Organization; it was also empowered to recognise the duty of development of meteorological science by experiments and special investigations.

From the early years of the twentieth century the collection of the climatological data of private observers became more and more associated with the Office, until now, by the transfer of the British Rainfall Organization, the co-ordination is completed, and the compilation of information of all kinds about weather is recognised as a common public duty centred in the Meteorological Office.

At the same time, in the course of the year, by a decision of the War Cabinet on May 8, 1919, the Office itself has been "attached" to the Air Ministry; and, instead of deriving the public funds for its maintenance directly from Parliament through the Treasury, it will receive them through the Air Council, and the Air Minister will be responsible to Parliament for them. What modifications of procedure are involved in the change are not yet known.

Since the year marks so important an epoch in meteorological history, the anniversary meeting of the

[1] Abstract of the presidential address delivered to the Royal Meteorological Society on January 21 by Sir Napier Shaw, F.R.S.

society is an occasion on which we may commemorate those of our countrymen who have contributed to the organisation and development of meteorological science. From the time of the invention of the barometer by Torricelli in 1643, proceeding in chronological order, we find examples of the experimental investigation of the properties of air in the work of the Hon. Robert Boyle (1627), natural philosopher and philanthropist; of the design of meteorological instruments in Robert Hooke (1635), the first demonstrator of the Royal Society; of the compilation of observations at sea in the remarkable discourse on winds by William Dampier (1652), sailor and buccaneer; of meteorological theory in Edmund Halley (1656), natural philosopher and Astronomer Royal; in George Hadley (1686), a lawyer who explained the trade winds; and James Hutton (1726), a physician who developed a theory of rain.

Next come Richard Kirwan (1733), a weatherwise Irish gentleman, "consulted about the weather by half the farmers of Ireland," with ideas about the meteorology of the globe on the basis of the distribution of temperature; Charles Wells (1757), physician of St. Thomas's Hospital, who elaborated the theory of dew; John Dalton (1766), famous for his atomic theory, teacher of mathematics and natural philosopher of Manchester, who put the theory of water-vapour in the atmosphere upon a physical basis, a lifelong meteorological observer, and a student of the aurora, the height of which he measured successfully; Luke Howard (1772), a successful manufacturing chemist, an assiduous meteorologist who classified clouds, introduced automatic records of the barometer, discoursed on the climate of London, and studied the influence of the phases of the moon; Admiral Sir Francis Beaufort (1774), Hydrographer of the Navy, who devised the Beaufort scale of wind-force and the Beaufort alphabetical notation for weather at sea; Sir Edward Sabine (1788), Royal Engineer, secretary and, later, president of the Royal Society, and also general secretary of the British Association, who obtained the co-operation of those three great agencies in the magnetic survey of the British Isles, the trigonometrical survey of India, and the establishment of magnetic observatories in Toronto, St. Helena, the Cape, India, and elsewhere in the British Dominions, and of meteorological observations at all the foreign and Colonial stations of the Royal Engineers and Army Medical Department, and who lived long enough to become the first chairman of committee of the Meteorological Office; John Frederic Daniell (1790), professor of chemistry, the inventor of the Daniell cell and the Daniell dew-point hygrometer, a meteorological essayist, and a writer on artificial climates for horticulture; and, finally, William Reid (1791), major-general of the Royal Engineers, and Henry Piddington (1707), merchant seaman, author of "The Sailor's Horn Book," who made most notable contributions to the analysis of the phenomena of what the latter first called "cyclones," and are now in their various forms the familiar elements of interest in the daily charts of weather prepared by meteorological offices all over the world. William Whewell (1796), the omniscient Master of Trinity, may perhaps be added as representing anemometry, thus carrying on the story of weather science as developed by those born before the end of the eighteenth century, and so bringing the history to the middle of the nineteenth, when the society was founded.

These names and histories show from what various sources meteorology has derived its ideas, its initiative, and its support. In the future, as in the past, the science must preserve its wide outlook.

THE REDUCTION OF WAVE ACTION IN HARBOURS.

THE important question of the best means of effecting the maximum reduction of wave action in harbour areas formed the subject of four papers read before the Institution of Civil Engineers on January 13. Next to affording the readiest and safest accessibility under extremely adverse conditions of weather and tide, the exclusion of storm waves, or rather their reduction within limits of harmlessness, is the most pressing concern of the harbour engineer. Unfortunately, the conditions essential to the attainment of the former desideratum are not often conducive to the realisation of the latter. The criticism has been passed on at least one modern harbour of importance that in tempestuous weather the sea is as rough inside as outside. Where large areas have to be enclosed in order to afford the necessary accommodation for shipping, it is a matter of considerable difficulty to provide simultaneously the equally necessary degree of shelter.

Four river harbours—those at the mouths of the Tyne, the Wear, the Esk, and the Blyth, all on the north-east coast of England—were under consideration. In the first two the principle of wide encircling piers had been adopted, with an entrance width on the Tyne of 1200 ft. and on the Wear of 700 ft.; in the second two there is the contrast of a comparatively narrow way or passage from 200 ft. to 400 ft. in width between fairly, or roughly, parallel piers, with intercepting jetties, or wave-traps, at intervals in their lengths. The semicircular arms afford expanding areas of large proportions, wherein the entering waves are diffused and a large amount of their energy dissipates itself harmlessly on spending beaches flanking the entrance to the inner harbour. On the other hand, the openings provided in the overlapping sides of parallel piers deflect a certain portion of the wave from its course and pass it out again to sea. Both systems have their merits, and all the authors claimed that the desired results had been obtained by the method adopted in the particular cases. At Blyth sea-waves of 10 ft. to 12 ft. in height at the pierheads are reduced to 6 in. to 24 in. in mid-harbour, while at Sunderland the factor of wave-reduction is 65 per cent.

In forming a judgment on the respective claims, it must be borne in mind that much depends on the character of the port. Obviously, an internal wave action which might be without prejudicial effect on a large mercantile liner might be fatal to small fishing craft. It is difficult also to detach the problem from the particular conditions of site and coastal configuration. Spending beaches are no doubt admirable adjuncts to a harbour, but they are not always available, nor are the financial resources of ports always commensurate with bold and ample schemes of accommodation. With the means at his disposal, the task of the engineer is to secure the best compromise possible: an adequate degree of tranquillity combined with a serviceable entrance width. Circumstances may favour one method or the other. Even after general lines have been laid down, it will certainly be found wise to proceed tentatively and cautiously in the execution of the design. Much useful information can be gained during the progress of the work, and the exact position and width of the entrance may often be left to a late stage of the operations.

BRYSSON CUNNINGHAM.

ST. ANDREWS INSTITUTE FOR CLINICAL RESEARCH.

THE recent opening of an institute for clinical research in St. Andrews marks the beginning of a new era in the scientific development of the art of medicine. The enterprise has been initiated and brought to a happy stage of working order by Sir James Mackenzie, who is the director and controlling mind of its endeavours.

Briefly, the object of the institute is to investigate the early symptoms of disease before structural alterations in the body have had time to take place. Hitherto research has been mainly concerned with disease and its more advanced forms when structural and chemical changes can be detected by ordinary laboratory methods. But at the beginnings of disease symptoms of various kinds, often seemingly trivial, do occur. They become familiar to many general practitioners, though no serious attempt has been made to determine their cause and significance and to draw up a classification which will enable the medical man to appreciate their real meaning and thus put him into the position of being able to detect and arrest incipient disease.

For such purposes a small centre of population, where the same patients can be seen frequently and observed over long periods of time, is preferable to the larger centre with its rapidly moving population. St. Andrews should provide an ideal site, and has the further advantage of possessing a university and medical school with all that these imply. A suitable building has been secured overlooking the bay and in close proximity to the historic golf course.

The institute is affiliated to the University. Its staff consists of a director, a director of laboratory research, a trained biological chemist, a bacteriologist (to be appointed), a whole-time clinical assistant, and several part-time clinical assistants who are also practitioners in the town.

Three days a week patients are examined, and two days are given over to general discussions. The latter are wide in scope, and are freely opened to anyone who has anything to contribute. The trained logician and psychologist are especially welcome, and not infrequently join in the debate.

The institute is also educative, and aims at the training of the practitioner in the methods of research.

The institute has now been at work for some months, and is already bearing fruit. It has promoted harmony and goodwill and a keen interest in their work among its members. It provides an excellent model for the development of other centres, and shows how a spirit of co-operation can be fostered among medical men which is of mutual benefit to themselves and to their patients. The scientific results will follow.

P. T. HERRING.

FISHERY INVESTIGATIONS IN SOUTH AFRICA.

THE Marine Biological Report of the Province of the Cape of Good Hope (No. 4) for the year ending June 30, 1918, has recently been received. The report is signed by Prof. J. D. F. Gilchrist, and although it appears that his department has been greatly restricted by lack of funds, it is clear that much useful work was done during the year under review. It is well known that a valuable industry in canning and exporting the local crawfish has been developed successfully at the Cape in recent years, and perhaps the most interesting feature of the report is an account of the habits of the different larval stages of this crustacean. The first larva of *Jasus lalandii* is small, somewhat opaque, and swims at the surface by its feather-like antennæ, the other appendages being folded close to the body and not used. This first stage, known as a "naupliosoma," continues for only a few hours, when it passes into the flattened "phyllosoma" stage. The larvæ in this stage are able to swim in a horizontal direction, but their natural habitat is still the surface waters. They were successfully reared, and after three or four days at most they passed into the third larval stage, in which they descend to the bottom and seek out the darkest corners. They then feed actively on the small animal and vegetable particles in the mud and sand, and are comparatively free from the attacks of their enemies. After undergoing a series of moults, which do not yet appear to have been followed in detail, the larva enters the "puerulus" stage, which has hitherto been found only close inshore.

Details of a number of experimental hauls for crawfish in different localities are given in the report, as well as an account of some marking experiments, which have thrown light upon the migrations of this crustacean. A useful list is added of the different species of lobsters and crawfishes found in South African waters, with short, popular descriptions drawn up by Mr. K. H. Barnard. Prof. H. B. Fantham contributes a short article on parasitic protozoa found in South African marine fishes, and the third and final list of Cape fishes, drawn up by the late Mr. W. Wardlaw Thompson, is included in the report. The strong recommendation of Prof. Gilchrist that the scientific fishery investigations, which have been suspended for a number of years, should now be resumed is one which will have the hearty support of all marine biologists, who know the valuable work which was formerly carried out under his direction.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At the meeting of the council held on January 29, the Pro-Vice-Chancellor in the chair, Mr. C. Grant Robertson received a cordial welcome as Principal of the University.

The thanks of the council have been accorded to Mr. Arthur Serena for his generous offer to provide a sum of 5000*l.* towards the endowment of a department of Italian studies and a chair of Italian. Also to Mr. John Smith, of Edgbaston, for his offer to endow a prize for students in metallurgy in some educational establishment or establishments in Birmingham, to commemorate the contributions made by Prof. Turner to the science of metallurgy, to be known as "the Thomas Turner prize (or prizes) in metallurgy."

Lt.-Col. J. E. Dixon (Messrs. Rabone Bros.), Mr. Frank Gower (the Birmingham Aluminium Casting Co.), and Mr. Donald Hope (Messrs. Kynochs, Ltd.) have been appointed members of the Commerce Advisory Board.

Prof. John Robertson and Dr. C. J. Lewis have been appointed representatives of the University at the Congress of the Royal Sanitary Institute to be held in Birmingham in July next.

Mr. James Young has been appointed an assistant lecturer in the department of physics.

CAMBRIDGE.—The offer of a fund to endow a John Couch Adams astronomership in the University is announced. The offer was made by the late Mrs. Adams, widow of Prof. Adams, the discoverer of Neptune. The post, if established, is to be held by the director of the observatory unless he be at the same time a professor of the University, in which

case it should be held by a duly qualified person of skill and experience in astronomy not necessarily a member of the University. The income of the fund is about 300*l.*

A further offer is made by the family of the late Dr. E. G. Fearnsides to endow an E. G. Fearnsides scholarship to further clinical research among the organic diseases of the nervous system. The scholarship would be held by Cambridge men for two years between the ends of their fourth and eleventh years. The award is biennial, and the income 50*l.* a year.

Mr. H. M. Fox, Mr. F. Debenham, and Mr. C. N. H. Lock have been elected fellows of Gonville and Caius College for research work in zoology, geology, and mathematics respectively.

LONDON.—Dr. Samuel Smiles has been appointed to the Daniell chair of chemistry tenable at King's College in succession to Prof. A. W. Crossley. Last year Dr. Smiles was appointed professor of organic chemistry at Armstrong College, Newcastle, and since 1913 he has been senior honorary secretary to the Chemical Society.

Dr. H. E. Roaf has been appointed to the University chair of physiology tenable at the London Hospital Medical College. From 1902 to 1905 Dr. Roaf held the Johnston Colonial fellowship in the University of Liverpool, where he has also been assistant lecturer on, and senior demonstrator of, physiology and histology and lecturer on chemical physiology. Since 1911 he has been lecturer on physiology at St. Mary's Hospital Medical School. For three years during the war he was in charge of the pathological laboratories at Cairo.

Prof. T. Swale Vincent has been appointed to the University chair of physiology tenable at the Middlesex Hospital Medical School. Prof. Vincent was formerly demonstrator of physiology in the University of Birmingham and Sharpey scholar and assistant professor of physiology at University College, London. Since 1904 he has been professor of physiology and biochemistry in the University of Manitoba.

The cordial thanks of the Senate have been voted to the general committee formed to promote the institution of degrees in commerce and the organisation of commercial education in the City of London and throughout the Empire for a gift of 50,000*l.* to be devoted to the extension of the buildings of the London School of Economics upon land provided for this purpose at a nominal rent by the London County Council.

A resolution was adopted by the Senate on January 28 expressing appreciation of the generosity of Messrs. S. B. and J. B. Joel in presenting 20,000*l.* for the endowment of a University chair of physics tenable at the Middlesex Hospital Medical School. Steps are being taken immediately for the appointment of the first incumbent of this professorship, which will bear the name of the donors.

The Franks studentship in archæology is open to a student qualified to undertake research or to prepare for the same. It is for the period of a year, and of the value of 50*l.* Full particulars are obtainable from the Academic Registrar of the University of London, South Kensington, and applications for the studentship must be received by, at latest, the first post of March 2.

The following doctorates have been conferred:—*D.Lit.*: Mr. R. E. M. Wheeler, an internal student, of University College, for a thesis entitled "Comparative Notes on Rhenish Potterv of the Roman Period." *D.Sc.* (*Engineering*): Mr. Marcel Tolkowsky, an internal student, of the Imperial College, City and Guilds College, for a thesis entitled "Diamond Grinding, Abrading, and Polishing."

MANCHESTER.—Mr. Frank Watts has been appointed lecturer in psychology in the University. Mr. Watts is the author of the recently published book, "Echo Personalities," a study of the contributions of abnormal psychology towards the solution of some problems of normal education.

OXFORD.—On February 3 Convocation resolved that Mr. E. S. Goodrich should be constituted professor of comparative embryology for so long as he holds the appointment of Aldrichian demonstrator in comparative anatomy. The resolution was proposed by the Rev. G. B. Cronshaw, Queen's College, and supported by Prof. Gilbert C. Bourne, Linacre professor of zoology and comparative anatomy.

The amended statute making the study of the Greek language optional for all students will come before Congregation on February 10. At a later date not yet fixed it will be submitted to Convocation. Opposition may be expected, as in many quarters it is not considered desirable that candidates for honours in such schools as that of "Literæ Humaniores" should be exempted from the study of Greek. If Prof. Gilbert Murray's amendment, exempting all science men, mathematicians, and passmen, had been carried, it is probable that no opposition would have been offered to the statute on the part of the advocates of Greek.

COMMDR. C. HAWKES has been appointed to succeed Prof. R. L. Weighton in the chair of engineering at Armstrong College, Newcastle-upon-Tyne.

DR. T. F. SIBLY, at present professor of geology at Armstrong College, Newcastle-upon-Tyne, has been appointed principal of the University College of Swansea.

SIR ARCHIBALD GARROD will deliver the Schorstein memorial lecture at the London Hospital Medical College on Friday, February 20, at 4 o'clock. The subject will be "Diagnosis of Disease of the Pancreas."

THE Women's Medical Association of New York City is offering the Mary Putnam Jacobi fellowship of about 200*l.* for post-graduate study in any country to any woman physician for work in any branch of medical science. Particulars are obtainable from Dr. Murrell, 86 Porchester Terrace, W.2.

THE lectures for teachers on recent developments in science arranged by the London County Council include a lecture on "Aviation" to be given by Mr. F. Handley Page at King's College, Strand, W.C.2, on Saturday, February 28, at 11 a.m. The chair will be taken by Sir Arthur Duckham, K.C.B.

A REUNION dinner of Old Centralians—the first to be held for six years—will take place on Saturday, February 21, at the Waldorf Hotel, Aldwych, W.C.2, tickets for which may be obtained from Mr. G. W. Tripp, Lyndhurst, Hayes Road, Bromley, Kent. We understand that Prof. Armstrong, Sir Alfred Keogh, and Prof. Unwin have accepted invitations to be present.

A CORRESPONDENT informs us that the New South Wales Parliament, in the session that closed in December last, passed an Act granting the University of Sydney a sum of 300,000*l.* for building purposes, the grant to consist of six annual instalments of 50,000*l.* The grant is in addition to the statutory endowment, and is called for by the rapid growth of all the departments of the University. It will allow the University to devote the whole of the McCaughey bequest to the extension of the present resources in

staff and equipment, and the encouragement of research.

A SCHEME for the establishment of a University Bureau in the City of London in connection with the University of London commerce degree is described in the *Times* of January 30. It is proposed that the bureau shall assist in the suitable and wide employment of commerce degree students and graduates in all branches of trade and commerce throughout the country and assist employers in all matters affecting the training and employment of all such students and graduates. An initial sum of 50,000*l.* has been set aside for the purpose of establishing the bureau on a proper footing.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 22.—Sir J. J. Thomson, president, in the chair.—Prof. E. G. **Coker** and K. C. **Chakko**: The stress-strain properties of nitro-cellulose and the law of its optical behaviour. The physical properties of nitro-cellulose are studied from its behaviour in tension, whereby values of Young's modulus and Poisson's ratio are obtained and the form of the load-extension curve is determined. The optical properties of the transparent material are observed, with special reference to its behaviour under load; and it is shown, by observations with a comparison beam not stressed beyond elastic limit, that the relative retardation produced between the two components of a polarised beam is consistent with a linear optical stress law, which holds up to stresses of about twice those at the elastic limit. These results are confirmed by observations of the retardation bands produced in a polarised spectrum by a beam under uniform bending moment. The stresses and strains are deduced on the assumption of a linear stress-optical law, and stress-strain curve so obtained is found to agree with purely mechanical measurements of a tension member.—S. **Marsh**: Alternating-current electrolysis. The behaviour of platinum, gold, and nickel electrodes during the passage of an alternating current of 25 to 80 cycles per second has been examined. The electrolytes employed were dilute sulphuric acid and barium hydrate solution. Curves representing the relation between volume of gas evolved and time of passage of current are of two distinct types: (*a*) One type resembling "saturation-current" curves in radio-activity. This effect is shown clearly in the cases of platinum and gold in an acid electrolyte. (*b*) A second type in which the rate of evolution of gas falls off with time until ultimately a steady rate of evolution sets in, *decreasing* in value with *increasing* frequency of the alternating current. Two possible explanations of the phenomena are discussed: (*a*) Adsorption of hydrogen at an electrode during one half-period, followed by recombination with oxygen in the succeeding half-period. (*b*) Oxidation of the electrode by the oxygen of one half-period, followed by reduction of the oxide by the hydrogen of the succeeding half-period. Evidence is given that the oxidation theory successfully explains the effects with gold and nickel. In the case of platinum it is believed that oxidation plays a prominent *rôle*, though adsorption also may be effective in this case. It is shown that the electrodes have an initial surface activity in promoting recombination, which activity increases (*a*) with frequency of alternation, and (*b*) up to a maximum value with the time of passage of the current. If the current density is less than that corresponding to this maximum activity, then sooner or later evolution of gas ceases. If the current density is greater, then after a time gas is evolved at a steady rate.—W. H. **Eccles** and J. H. **Vincent**: The variations of wave-length of the oscillations generated by three-electrode thermionic tubes due to changes in filament current, plate voltage, grid voltage, or coupling. When electrical oscillations are sustained in a circuit comprising inductance and electrical capacity by aid of a three-electrode thermionic vacuum tube of the kind used in wireless telegraphy, the frequency of the oscillations and the wave-length of the radiation depend principally upon the values of the inductance and the electrical capacity, but also partly upon the resistance in the oscillatory circuit; upon the voltages of the various batteries in use; upon the temperature of the filament supplying the electrons; upon other properties of the vacuum tube; and upon the coupling between portions of the circuit associated with the grid and the anode. The object of the present investigation was to study experimentally the effects of altering each of the chief variables, with the view of finding the conditions most favourable for the production of continuous oscillations of constant frequency. For this purpose two circuits were sustained in oscillation at nearly the same high frequency, namely, about 120,000 vibrations per second, and the audible beat between these frequencies was observed. Then changes made in one circuit alone caused variations of frequency that were measurable by acoustic observation of the beat-note. The preliminary investigations showed that variation of the heating current of a filament was the most fertile source of erratic changes of frequency, and resulted in the discovery that increase in the filament current of one tube produced at low values of current a decrease of frequency, and at higher values an increase of frequency, while at a certain value of filament current the frequency had a stationary value. This phenomenon provides a method of setting an oscillation generator so as to produce a vibration of frequency constant to less than one part in 100,000. Provided with this knowledge, the other problems enumerated above were attacked. In an apparatus in which the inductance was eight millihenries, the electrical capacity 250 electrostatic units, and the wave-length 2750 metres, it was found that raising the voltage of the anode battery from 130 to 140 increased the wave-length by 6 metres, and raising the grid voltage by 1 increased the wave-length about 10 metres. The coupling in the circuit produced large effects by its variation.—S. D. **Carothers**: Plane strain: the direct determination of stress. It is pointed out in the first part of the paper that in plane strain the stresses, if determined directly, are usually obtained by the aid of the well-known stress function method. The problem is usually that of finding a function χ satisfying $\nabla_1^4\chi=0$ throughout the body, with suitable values of χ over the various boundaries. The most general value of χ in Cartesian co-ordinates appears to be

$$\chi=A\theta+Bx\theta+Cy.\theta+D(x^2+yY\theta),$$

where A, B, C, and D are any constants and θ is any plane harmonic function. It is shown that for any orthogonal co-ordinates the stresses derived by the stress-function method when applied to $\chi=(x^2+y^2)\theta$ can always be resolved into two distinct sets, while in the case of Cartesian co-ordinates the stresses can be split up into four distinct sets. In view of the foregoing, the present paper has for its object the determination of the various sets of stresses which might legitimately occur in a state of plane strain, expressed in the simplest possible terms, with the view of rendering the building up of a given state of stress a manageable operation. The paper sets forth the usual stress equations of equilibrium,

and gives the identical relation between the strain components expressed in the various systems of co-ordinates. The various possible stress sets in rectangular and polar co-ordinates are then set forth in order, after which the solutions in orthogonal curvilinears are obtained in such a manner as generally to show their connection with those formerly given. The second part of the paper applies the results obtained to the solution of some examples.—F. **Horton** and Ann C. **Davies**: An investigation of the effects of electron collisions with platinum and with hydrogen, to ascertain whether the production of ionisation from platinum is due to occluded hydrogen. The effects of bombarding a platinum surface by electrons the velocity of which could be gradually increased have been investigated by methods in which these effects were detected when superposed on the original electron current, and also when they were measured independently. It has been found that a genuine ionisation by electron impacts is produced at a minimum electron velocity of 13·0 volts, but that up to electron velocities of 30 volts no detectable amount of radiation capable of acting photo-electrically on platinum is obtained. In order to ascertain whether the ionisation produced at a minimum electron velocity of 13·0 volts arises from the platinum or from hydrogen attached to its surface, the effects of electron collisions with hydrogen were investigated in the same apparatus. A radiation was detected from this gas at a minimum electron velocity of 10·5 volts, and a second type of radiation at a minimum electron velocity of 13·9 volts. Three types of ionisation were also detected, beginning when the electrons acquired velocities of 13·0 volts, 14·4 volts, and 16·9 volts respectively. The first of these types is the ionisation obtained in a high vacuum, and experiments described in the paper show that this is not due to hydrogen, but arises from the platinum itself. From the experiments in hydrogen it is concluded that the minimum electron velocity for the production of radiation from a hydrogen atom is 10·5 volts, the minimum electron velocity for ionisation of the atom 14·4 volts, and the minimum electron velocity for ionisation of the molecule 16·9 volts. These results are in general agreement with the deductions from Bohr's theory. The second type of radiation, beginning at an electron velocity of 13·9 volts, is attributed to the hydrogen molecule.—L. **Bairstow**, R. H. **Fowler**, and D. R. **Hartree**: The pressure distribution on the head of a shell moving at high velocities. This paper describes a first attempt to measure the pressure distribution on a body moving through a gas at velocities equal to or greater than the velocity of sound a in the gas. The body in question is a spinning shell, moving along its axis of symmetry, and the gas, air. The pressure at a given distance from the nose is communicated to a chamber in the head of the shell, and deduced from the time of burning a train of powder in this chamber, which is a quantity that can be directly observed. By a series of such observations the pressure at a given point of the head is determined as a function of the velocity ratio v/a, where v is the velocity of the shell relative to the air. Curves are obtained showing the variation of the pressure for values of v/a from 0·04 to 1·4, and for four different positions on the head of the shell.

PARIS.

Academy of Sciences, December 29, 1919.—M. Léon Guignard in the chair.—G. **Bigourdan**: The work of Lalande and his pupils at the Mazarin College.—H. **Deslandres**: Remarks on the constitution of the atom and the properties of band spectra. Completing four earlier communications on the same subject.—P. **Termier** and G. **Friedel**: The foldings and drift which have broken the Gard coal basin; probably Alpine movements of Miocene age.—A. **Blondel**: Graphical study of the working of audions with resonating circuit as sensitised receivers or as dampers.—C. **Sauvageau**: The parasitism of a red alga, *Polysiphonia fastigiata*.—F. **Carlson**: A property of polynomials of one variable.—M. **Mesnager**: Method of determination of the internal strains existing in a circular cylinder. The method employed by M. Portevin in a recent communication on the same subject, due to Heyn and Bauer, is faulty, as it only takes into account the tensions parallel to the axis of the cylinder. An outline of a more exact method is given.—J. **Amar**: A machine for cutting out brushes. This instrument has been specially designed for use by the blind.—E. **Kohn-Abrest**: Aluminium spontaneously oxidisable in the air. M. Guillet has recently described some aluminium alloys which undergo oxidation in the air. Some years ago the author found that aluminium could be volatilised in a vacuum at 1100° C., and the portion remaining unvolatilised sometimes proved to be spontaneously oxidisable. No satisfactory explanation of the phenomenon could be found.—N. R. **Dhar** and G. **Urbain**: The polarisation electromotive forces of iron in solutions of complex salts. Relation between these electromotive forces and the disappearance of the analytical characters of ferric ions. Measurements are given for ferrous and ferric salts, ferrocyanides, ferrioxalates, ferricyanides, and nitro-prussides.—E. **Wourtzel**: The dissociation constant of nitrogen peroxide.—L. **Vallery**: The estimation of arsenic in tin and in tinned articles. The arsenic is first separated by distillation as chloride and reduced to colloidal arsenic, and determined in a colorimeter. The determination of arsenic in tin by Marsh's method is liable to serious error.—A. **Meyer**: The estimation of thiophen in benzene.—A. **Kling** and D. **Florentin**: The production of carbon monoxide in flames of different gases. Carbon monoxide is mainly produced by sudden cooling of the flame; the amount is increased by contact with the mantle of an incandescent burner.—M. **Zeil**: Correlations between the Quaternary terraces, glacial recurrence, and upward movements of the earth's crust.—J. **Bourcart**: Cretacean and Lower Eocene formations and their extension in central and southern Albania.—Ph. **Glangeaud**: The reconstitution of a long lake depression which during the Oligocene period occupied the great coal cut of the Central Massif.—Ch. **Pussenot**: Glacial recurrences later than the "Néowürmien" in the massifs of the Aiguille de Polset (Tarentaise), of Mont Thabor, and of the Aiguille de Scolette (Maurienne).—W. **Kilian** and Ch. **Pussenot**: The age of the tufa-bearing human remains at Villard de Bozel (Savoie).—Ch. **Maurain**: The wind velocity in the stratosphere. There is a maximum mean wind velocity (14·55 metres per second) at a height of about 11,000 metres, falling to 8·04 metres per second at 19,000 metres altitude.—MM. **Stapfer** and **Moleski**: Remarks on snow-falls. Two cases are considered, the first when the snow has already been formed in the northern regions and the second when it is formed near where it falls. The conditions existing on the occasion of the fall of snow at Paris on November 3 are examined, and found to confirm the views expressed in earlier communications.—P. **Carles**: The blue *casse* of wine. Criticisms on a recent communication by M. Piedallu.—M. **Gard**: Biology of a new species of Euglæna (*E. limosa*).—L. **Lapicque**: Seasonal variation in the chemical composition of marine algæ. There is a great variation in the amount of soluble carbohydrate in *Laminaria flexicaulis*. These attain a maximum in August and September, and fall to a minimum at the end of the winter. The changes in ash are in the

inverse direction.—MM. G. **Bertrand**, **Brocq-Rousseu**, and **Dassonville**: Comparative action of chloropicrin on the weevil and on Tribolium. The two parasites possess unequal resisting powers towards chloropicrin vapour, the Tribolium requiring longer exposure for its destruction.—M. **Caullery** and F. **Mesnil**: *Ancyroniscus Bonnieri*, a new species, parasite of *Dynamene bidentata*.—M. **Nicolle**, E. **Debains**, and E. **Césari**: The mutual precipitation of toxins and their antitoxins. Application to the titration of antidiphtheritic and antitetanic sera. The method of titration *in vitro*, for which great economy of time and money is claimed, has been proved to correspond with tests made *in vivo*.

MELBOURNE.

Royal Society of Victoria, December 11, 1919.—Mr. F. H. Wisewould, vice-president, in the chair.—F. **Chapman**: Tertiary fossils from Ooldea: Additional note. The author records a further series of fossils from this locality, collected by F. A. Cudmore, which confirms his earlier determination of their Miocene age.—Ellinor **Archer**: Longevity of cut flowers. Preliminary observations were made on Acacia blossoms and other plants. A solution of lead nitrate gave good results in preventing the vessels from being blocked, allowing the blossoms to last for weeks instead of days. Silver nitrate also acted in the same way, but not so efficiently.—E. **McLennan**: The endophytic fungus of Lolium: its development, distribution, and function. Instead of being parasitic, this fungus is now an essential part of the plant and plays an important *rôle* in the ripening of seed. In the ripe seed the remains of the hyphæ persist mainly in the resting endospermic combium (aleurone layer).—Jean **Shannon**: The structure of *Megascolex Fletcheri*, sp.nov. This is one of the few Australian earthworms which have been carefully worked out in detail.—J. T. **Jutson**: Notes on dust-whirls in subarid Western Australia. The author has had good opportunities of studying these and other æolian agencies. The occurrence of dust-whirls is practically confined to the summer months. Their general mode of rotation is counter-clockwise, although some are observed to take place in the opposite direction.—A. V. E. **James**: The physiography and geography of the Bulla-Sydenham area. In this paper a detailed account is given of the palæography of the Saltwater River and Deep Creek, the age and fossiliferous contents of the sedimentary rocks between Bulla and Keilor, and the occurrence of the igneous rocks in this area, including basalt and kaolin.

BOOKS RECEIVED.

Penrose's Annual. Pp. x+112+plates. (London: P. Lund, Humphries, and Co., Ltd.) 10*s*. 6*d*. net.

Elementary Practical Chemistry for Medical and Other Students. By Dr. J. E. Myers and J. B. Firth. Second edition. Pp. viii+194. (London: C. Griffin and Co., Ltd.) 4*s*. 6*d*.

Insect Life in Sewage Filters. By Dr. W. H. Parkinson and H. D. Bell. Pp. viii+64. (London: The Sanitary Publishing Co., Ltd.) 3*s*. 6*d*. net.

A Night Raid into Space: The Story of the Heavens told in Simple Words. By Col. I. S. F. Mackenzie. Pp. 143. (London: H. Hardingham.) 2*s*. 6*d*. net.

A Practical Handbook of British Birds. Part vi. Pp. 337–400+2 plates. (London: Witherby and Co.) 4*s*. net.

Ferrari's Dioptric Instruments: Being an Elementary Exposition of Gauss's Theory and its Applications. Translated by Dr. O. Faber. Pp. xxxi+214. (London: H.M.S.O.) 4*s*. net.

The Engines of the Human Body. By Prof. A. Keith. Pp. xii+284+ii plates. (London: Williams and Norgate.) 12*s*. 6*d*. net.

A Synoptical List of the Accipitres. By H. Kirke Swann. Part iii. (London: J. Wheldon and Co.) 4*s*.

Man: Past and Present. By A. H. Keane. Revised and largely rewritten by A. H. Quiggin and Dr. A. C. Haddon. Pp. xi+582+xvi plates. (Cambridge: At the University Press.) 36*s*. net.

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Chemistry for Public Health Students. By E. G. Jones. Pp. ix+244. (London: Methuen and Co., Ltd.) 6*s*. net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. E. Conrady: Recent Progress in Applied Optics.

ROYAL SOCIETY, at 4.30.—J. H. Jeans, Prof. A. S. Eddington, Sir F. Dyson, Prof. A. Fowler, E. Cunningham, Prof. H. F. Newall, Prof. F. A. Lindemann, and possibly Sir J. Larmor: Discussion on the Theory of Relativity.

LINNEAN SOCIETY, at 5.—Dr. R. Ruggles Gates: The Existence of Two Fundamentally Different Types of Characters in Organisms.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Dr. E. C. Morland: Climate in Tuberculosis.

CHEMICAL SOCIETY, at 8.—(Ordinary Meeting, followed by an Informal Meeting.)

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Dr. Goodall: The Origin of Tumours of the Ovary.—G. Ley: A Statistical Report of Carcinoma of the Ovary as met with in the Patho-

logical Institute of the London Hospital between the years 1907-1919 inclusive, showing the Relative Frequency of Primary and Secondary Ovarian Carcinoma.

FRIDAY, FEBRUARY 6.

GEOPHYSICS COMMITTEE (at Royal Astronomical Society), at 5.—Sir Charles Parsons and Others: The Practicability of, and Scientific Advantages to be derived from, a Deep Boring.

ROYAL COLLEGE OF SURGEONS, at 5.—V. Z. Cope: The Surgical Aspect of Dysentery.

CONCRETE INSTITUTE (at Denison House, 296 Vauxhall Bridge Road), at 6.—H. J. G. Bamber: The Practical Testing of Cement.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting) (at the City and Guilds (Engineering) College), at 7.—F. R. Housden: Electric Lifts and Cranes.

JUNIOR INSTITUTION OF ENGINEERS (at 39 Victoria Street), at 7.30.—Capt. J. Bradford: Tank Work in the Army.

TECHNICAL INSPECTION ASSOCIATION (at the Royal Society of Arts), at 7.30.—J. Waite: The Treatment of Steel.

ROYAL SOCIETY OF MEDICINE (Anæsthetics and Laryngology Sections), at 8.30.—Dr. F. S. Rood and Others: Discussion on Anæsthesia in Throat and Nose Operations.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. Sir Walter Raleigh: Landor and the Classic Manner.

SATURDAY, FEBRUARY 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir F. W. Dyson: The Astronomical Evidence bearing on Einstein's Theory of Gravitation. II. Displacement of Solar Spectral Lines.

MONDAY, FEBRUARY 9.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Capt. H. Alan Lloyd: Characteristics of the Ground as seen from the Air.

ROYAL COLLEGE OF SURGEONS, at 5.—H. T. Gray: The Influence of Nerve Impulses on Gastro-intestinal Disorders.

BIOCHEMICAL SOCIETY (at Imperial College of Science and Technology, Botany Building), at 5.30.—H. Chick and E. M. Hume: Production in Monkeys of Symptoms closely Resembling Pellagra, by prolonged Feeding on a Diet of Low Protein Content.—C. C. Wood and S. B. Schryver: Demonstration of Method of Determining the Methoxyl Groups in Plant Tissues.

ROYAL SOCIETY OF MEDICINE (War Section), at 5.30.—Sir Wilmot Herringham and Others: Discussion on Gas Poisoning.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Association), at 8.—Dr. C. C. Carpenter: Fuels.

MEDICAL SOCIETY OF LONDON, at 8.30.—Dr. H Drinkwater: The Clinical or Naked Eye Diagnosis of Diphtheria and other Infections of the Fauces.—Dr. T. B. Hyslop: Some New Methods of Illustration.

TUESDAY, FEBRUARY 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. G. Elliot Smith: The Evolution of Man and the Early History of Civilisation. III. The Search for Gold.

ROYAL SOCIETY OF MEDICINE, at 5.—Prof. A. D. Waller: The Measurement of Human Emotion and of its Voluntary Control (Occasional Lecture).

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—P. M. Crosthwaite: Experiments on the Horizontal Pressure of Sand.—Dr. A. R. Fulton: Overturning Moment on Retaining-Walls.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. P. Chalmers Mitchell: Report on the Additions made to the Society's Menagerie during the months of November and December, 1919.—R. I. Pocock: Exhibition of Photographs of a Chinese Serow.—H. R. Hogg: Some Australian Opiliones.—Dr. C. F. Sonntag: Description of the Larynx and Œsophagus of a Common Macaque, exhibiting several unusual Features.—R. E. Turner and J. Waterston: A Revision of the Ichneumonid Genera Labium and Pœcilocryptus.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Annual General Meeting.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—Annual General Meeting.

WEDNESDAY, FEBRUARY 11.

ROYAL UNITED SERVICE INSTITUTION, at 3.—Col. F. C. Fuller: The Tank Corps.

ROYAL SOCIETY OF ARTS, at 4.30.—Lieut.-Comm. N. Wilkinson: Naval Camouflage.

ROYAL COLLEGE OF SURGEONS, at 5.—J. Sherren: The Late Results of the Surgical Treatment of Chronic Ulcers of the Stomach and Duodenum (Hunterian Lecture).

THURSDAY, FEBRUARY 12.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. E. Conrady: Recent Progress in Applied Optics.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: J. W. McBain and C. S. Salmon: Colloidal Electrolytes. Soap Solutions and their Constitution.—C. C. Farr and D. B. Macleod: The Viscosity of Sulphur.—C. V. Raman and B. Banerji: Kaufman's Theory of the Impact of the Pianoforte Hammer.—Commander T. Y. Baker, R.N., and Prof. L. N. G. Filon: A Theory of the Second Order Longitudinal Spherical Aberration for a Symmetrical Optical System.—Dr. S. Chapman: A Note on Dr. Chree's Discussion of Two Magnetic Storms (Title only).—Dr. C. Chree: An Explanation of the Criticisms on Dr. Chapman's Recent Paper "An Outline of a Theory of Magnetic Storms" (Title only).—Prof. J. W. Nicholson: The Lateral Vibrations of Sharply Pointed Bars.—R. E. Slade: A New Method of Spectrophotometry in the Visible and Ultra-violet and the Absorption of Light by Silver Bromide.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—Dr. C. W. Kimmins: The Dreams of Children in Blind, Deaf, and Industrial Schools.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Major K. Edgcumbe: The Protection of Alternating-current Distribution Systems without the Use of Special Conductors.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 2 Furnival Street), at 7.—Dr. R. S. Morrell: Colloid Chemistry of Paints and Varnishes.

OPTICAL SOCIETY, at 7.30.—J. W. French: The Surface Layer of an Optical Polishing Tool.—Mrs. C. H. Griffiths: Aberration Effects in Star Images.—R. W. Cheshire and W. Shackleton: The Testing of Heliograph Mirrors.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduate Section) (at 28 Victoria Street), at 8.—F. R. Cowell: Steering Gears.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Dr. Rows: Anxiety States.

FRIDAY, FEBRUARY 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 5.—Prof. C. H. Lees: Presidential Address.—Sir Arthur Schuster: Atmospheric Refraction during Total Solar Eclipses.—To be followed by the Annual General Meeting.

ROYAL COLLEGE OF SURGEONS, at 5.—W. G. Spencer: The Historical Relationship between Experiments on Animals and the Development of Surgery.

MALACOLOGICAL SOCIETY OF LONDON (at the Linnean Society), at 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. W. M. Bayliss: The Volume of the Blood and its Significance.

SATURDAY, FEBRUARY 14.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir F. W. Dyson: The Astronomical Evidence bearing on Einstein's Theory of Gravitation. III. Deflection of Light in the Sun's Gravitational Field.

CONTENTS.

	PAGE
The Need for Aircraft Research	589
Physiology of Muscular Exercise	590
Theories of Sound Perception. By **J. G. M.**	591
Kashmir and Indian Silks	591
A Great Industrialist	592
Farming in the New Era. By **Dr. E. J. Russell, F.R.S.**	592
Our Bookshelf	594
Letters to the Editor:—	
The Nature of the Katmai Volcanic Gases and Encrustations. (*Illustrated.*)—**J. W. Shipley**	595
The Control of Scientific and Industrial Research.—**Dr. Morris W. Travers, F.R.S.**	597
The Predicted Shift of the Fraunhofer Lines.—**James Rice; Prof. A. S. Eddington, F.R.S.**	598
The Straight Path.—**Dr. A. A. Robb**	599
Entente Scientific Literature in Central Europe during the War.—**Prof. Bohuslav Brauner**	600
Percussion Figures in Isotropic Solids.—**W. J. Lewis Abbott**	600
Change of Colour in Plumage of Captive "Sunbirds" or "Honey-suckers."—**Harold Millar**	600
Mathematics in the United States. By **G. B. M.**	601
Shackleton's Last Antarctic Expedition. (*Illustrated.*) By **W. S. B.**	602
Telephoning by Light. (*Illustrated.*) By **Prof. A. O. Rankine**	604
Australian Rainfall and Wheat Yield. By **W. W. B.**	606
Notes	607
Our Astronomical Column:—	
Comets	612
The Motion of the Moon	612
Stars of High Velocity	612
The St. Louis Meeting of the American Association	612
Pioneers in the Science of the Weather. By **Sir Napier Shaw, F.R.S.**	613
The Reduction of Wave Action in Harbours. By **Dr. Brysson Cunningham**	614
St. Andrews Institute for Clinical Research. By **Prof. P. T. Herring**	615
Fishery Investigations in South Africa	615
University and Educational Intelligence	615
Societies and Academies	617
Books Received	619
Diary of Societies	619

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